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ABSTRACT

A computer based business game to be used as a teaching tool in high school business-related courses was designed, developed, and tested. The game is constructed in modules that can be linked together in a variety of ways to achieve a different decision configuration for different class needs and a changing configuration over time to parallel the progression of the class. During the course of the project, a business environment was simulated with a mathematical model. The model was programed in FORTRAN IV, installed on a time sharing computer system, and documented for high school participants and a game administrator. The model was carefully tested prior to a full administration in a high school economics class. It was found that the model developed had the advantages of stability, rationality, and controllability, although it was found to be too competitive in the marketplace allowing the results of teams' decisions to be extremely separated. (Author/SP)

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FINAL REPORT

Project No. 9-B-032
Grant No. OEG-2-9-480032-1024(010)

"Development and Testing of a High School Business Game"

Douglas D. McNair
and
Alfred P. West, Jr.

3401 Market Street
Philadelphia, Pennsylvania 19104

August 1, 1969

U.S. DEPARTMENT OF
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TABLE OF CONTENTS

Page

I. A. SUMMARY 1

II. A. PROBLEMS AND OBJECTIVES 1

II. A. 1. Problem Statement
II. A. 2. Rationale
II. A. 3. Objectives

III. A. DESCRIPTION OF ACTIVITIES 4

III. A. 1. Task I - Initial Game Design
III. A. 2. Task II - Programming and Debugging
III. A. 3. Task III - Writing Instructions to Participants
III. A. 4. Task IV - Testing Through Team Play
III. A. 5. Task V - Documentation of Administrator Participation

IV. A. COST ESTIMATES FOR RUNNING THE HIGH SCHOOL BUSINESS GAME 9

V. A. FINDINGS 10

V. A. 1. Findings Pertaining to the Computer Model
V. A. 2. Findings Pertaining to the Administration

VI. A. CONCLUSIONS AND RECOMMENDATIONS 12

VI. A. 1. Conclusions
VI. A. 2. Recommendations

APPENDIX A Representative Computer Printouts 14

APPENDIX B The Program 30

APPENDIX C Instructions to Participants 45

APPENDIX D Participants' Evaluation 59

APPENDIX E Instructions to Administrator 64

I. A. SUMMARY

The purpose of the project reported in these pages was to design, develop, and test a computer based business game to be used as a teaching tool in high school business-related courses. The game is constructed in modules that can be linked together in a variety of ways to achieve a different decision configuration for different class needs and a changing configuration over time to parallel the progression of the class.

During the course of the project, a business environment was simulated with a mathematical model. The model was programmed in FORTRAN IV, installed on a time sharing computer system, and documented for high school participants and a game administrator. The model was carefully tested prior to a full administration in a high school economics class.

It was found that the model developed had the advantages of stability, rationality, and controllability. The simulated environment remains stable in the face of inappropriate decisions, responds in a manner consistent with economic principles, and contains no opportunity for "gaming". The environment has the disadvantage that it is too competitive in the marketplace; this allows the results of teams' decisions to be extremely separated. It was also found that the module concept works well in practice, making the business environment both flexible and easy to administer. Decisions contained in the modules were well within the learning capacity of high school students, especially when they were introduced in a stepwise fashion. Furthermore, time sharing was found to be a most effective way to administer the business game.

It is recommended that the competitive nature of the simulated market be toned down; the costs of administration be investigated further; a method of implementation be developed; and finally an extensive pilot test be run prior to offering the business game nationwide. The business game and other such games have the capability, when coupled with time sharing, to be offered to geographically dispersed high schools. All the high school would require is a teletype console.

II. A. PROBLEMS AND OBJECTIVES

This paper reports on a project to design and develop a computer based business game for use as a teaching tool in high school business-related courses.

II. A. 1. Problem Statement

There exists today in high school business education a need for a means of involving the student in a situation that will demand behavior consistent with the future for which the student is being prepared. At the same time, there is a need for providing means for both slow and fast students to expand the limits of the learning experience to fit their abilities. For business education, a teaching tool that promises to satisfy both these needs is the business game.

By simulating a business environment, the game offers an opportunity for the student to apply some of the "textbook" principles taught in formal class, to discover difficulties involved in their application, and to experiment with these principles and other tactics of play. The game places the student in a "real" environment of competition, group decision making, and uncertainty. The complexity of the simulated environment adds realism to the student's learning process. At the same time, the flexible nature of the decisions allows great variation in the amount and rigor of technical analysis that can be employed. This flexibility provides ample room for highly motivated and capable students to expand the learning experience to fit their caliber, and at the same time, accommodate the slower student.

Simulated business environments, or business games, have found expanded use at the university level where they were initially developed and tested. A few universities that presently use them are: Harvard University, Stanford University, MIT, UCLA, Carnegie Institute of Technology and the University of Pennsylvania. Extrapolating the experiences of these and other universities, the use of a computer-based business game as an instructional tool in high schools should prove to be most worthwhile.

II. A. 2. Rationale

There are three general rationale that either were part of the impetus for development of a simulated environment for student decision-making or have evolved after test and evaluation of a number of business games.

These rationale are:

(1) A business game aids in the teaching of economic, business, and accounting principles.

(2) A business game generates an analytical involvement by the student in a complex and dynamic environment.

(3) A business game generates a social involvement by the student in the task-oriented group of which he is a member.

With respect to the first rationale, the game is a direct extension of the textbook, much as laboratory experience in the physical sciences. By using certain business or economic principles, the student becomes more familiar with the theory and application of these principles.

The second rationale is based on the simulation model's ability to generate dynamic business-like problems which the student must cope with over an extended period of time. This rationale emphasizes the decision-making nature of the game. It gives the student a chance to develop a strategy of decision-making and to monitor this strategy over time in a competitive, uncertain environment. The game, by involving uncertain events, elements of risk, and a complex payoff function, is played as an iterative process in which feedback information, printed in a standard business report format, is used by the student as a basis for evaluating and revising decision criteria.

The third rationale is derived from the fact that decisions in a business game are made by groups of students. By placing the game participants in teams, students are encouraged to identify with a role and to assume a responsible attitude toward their behavior and the game environment.

These rationale are the same for the use of business games in high school. The major difference between the university and high school game should be a reduction in the number of complex decisions to be made by the high school student. The game complexity must be reduced for high school because the set of business decision-making principles is not as large.

This reduction in complexity should not detrimentally affect the possible benefits to be had from business games, especially since a decrease in the game complexity does not mean a corresponding decrease in the complexities of game play. Much is learned by making decisions within a group. The students gain as much from collectively reflecting on past actions and experiences in attempting to justify further decisions as from the specific nature of the decisions they are asked to make.

There is a constraint on how much complexity can be deleted even for high school play. In general, a simulated environment must be complex in play to be realistic. This level of complexity necessary for realism might very well be so high as to overwhelm the high school student at the start of the game and discourage further participation. To allow for both realism and a low initial game complexity, the objectives outlined below include a capability for modular implementation of game play. Thereby, the game can be initiated in a simple form which can be quickly grasped by the student. Complexity can be added in a step-wise fashion so more complex techniques can be employed as the game progresses.

II. A. 3. Objectives

The major objective of this project has been to design, develop, and test a computer-based business game to be used in high school classes of micro-economics, business principles and policies, and accounting. The secondary objectives are directed toward enhancing the implementation of the game. The game was designed and documented in such a way as to (1) make the play of the game easily understood by the participants, (2) make the game easy to direct by a game administrator, and (3) make the structure of the game as flexible as possible. By striving to make the implementation of the game simple and yet flexible, the general applicability of the game has been improved.

The operational objectives correspond to the particular specifications of the proposed game. These specifications are as follows:

(1) The game environment involves a single product, multiple firms and a segmented market. Groups of students represent firms and will compete for sales of the product in various marketing zones while attempting to minimize production and marketing costs.

(2) The game involves a relatively small number of team decisions as compared with games played at the university level. Decisions are made in the functional areas of production, procurement, marketing and finance.

(3) The game is well documented. Instructions for the participants and the game administrator, as well as the simulated environment, are included in the game documentation.

(4) The game is of modular construction so that decisions can be added to a basic framework as the class progresses in the learning of business principles.

(5) The program has been prepared for installation on time sharing computer systems.

III. A. DESCRIPTION OF ACTIVITIES

There were five tasks accomplished in the design and development of the business game outlined above. These tasks, in order of initiation, are as follows:

Task I Initial Model Design

Task II Programming and Debugging of the Simulated Environment

Task III Documentation of Team Participation

Task IV Testing Through Team Play

Task V Documentation of Administrator Participation

The remainder of this section details accomplishments with respect to each of these tasks and documents successes and failures during a test administration at Lower Merion Senior High School, Ardmore, Pennsylvania.

III. A. 1. Task I - Initial Game Design

The business environment being simulated responds to decisions by the participants in a manner consistent with general principles of macro- and micro-economics. To insure this response, the proposed game was designed to include the following:

(A) Macro-economic responses

(1) An increase in average industry price generates a decline in market demand. At the margin, price elasticity is controlled by the administrator.

(2) An increase in average national marketing effort results in an increase in average market demand across all zones. Return to industry marketing effort exhibits diminishing marginal productivity above a minimum level.

(3) As average product quality increases, demand increases but exhibits diminishing marginal productivity.

(4) Increased zonal marketing effort produces an increase in demand in that zone. Again, this relationship demonstrates diminishing marginal returns.

(5) As the level of general economic activity increases (shown by increases in general economic indicators), industry demand increases. A similar effect is reflected in those economic indicators that are peculiar to zones.

(6) The prices of raw materials is dependent on industry demand. (Raw material prices are not perfectly elastic.)

(B) Micro-economic responses

(1) A firm's potential market share declines as its price increases relative to prices offered by other firms.

(2) A firm's potential market share increases with increasing marketing effort (zonal and national) relative to other firms.

(3) A firm's potential market share increases with increasing expenditures for product development relative to other firms.

(4) Per unit production costs decrease with increases in plant capacity up to a certain point.

(5) Production capacity falls if maintenance expenditures are insufficient to counteract equipment deterioration.

(6) Per unit operating costs decline with improved plant utilization (i.e., multiple shift, etc.)

(7) With greater production volumes, equipment deterioration is increased.

(8) As expenditures for marketing research increase, the quality of information will, in general, improve. There is a small random element present in the quality of marketing research.

It is within this environment, then, that teams make decisions. Consistent with the stated objective of model simplicity, a list of sixteen team decisions in the functional areas of production, procurement, marketing, and finance has been prepared. These decisions are:

0	Production quantity	3	Zonal marketing
0	Raw materials purchase	4	Product development
0	Employees hired	5	Plant maintenance
0	Employees fired	6	Marketing research
0	Plant investment	7	Loans
0	Product price	7	Loan repayment
1	Shipments to zones	7	Dividends paid
2	National marketing	7	Investment in bonds

The number preceding each decision in the above list denotes the module to which it is assigned. An "0" indicates the decisions that comprise the minimum decision module. At the very least, this module must be used at the start of any game. The other decision modules can be added in any order or in any combination. Thus, this single game has one hundred twenty possible different decisions configurations.

When a particular module is eliminated from the operative decision set, an appropriate default routine will come into play. These default routines generate defacto decisions that are economically justifiable and treat all firms equally. For example, the elimination of the shipping module results in automatic shipments proportional to zonal demand potential.

III. A. 2. Task II - Programming and Debugging

Before this task could be started, two decisions had to be made: which computer language to use and which computer system to use. For reasons of convenience and availability, all programming has been done using the FORTRAN IV language. The second decision posed more of a problem. After considerable investigation, it was decided that the project should make use of a time sharing computer system rather than a batch system.

A time sharing computer system makes use of standard voice grade telephone lines to communicate data and instructions from geographically dispersed users to a central computing facility. All that the user requires "in-house" is some form of terminal device. A standard terminal device is a teletype unit (Model 33 ASR) that rents for approximately $90 per month. By using such a system, the game becomes independent of any single physical location, allows a high school district that does not have a computer to use the game at a very nominal cost, and considerably reduces the administrative effort of using the game. The computer system chosen was Computer Network Corporation which employs a Borroughs 5500 Computer.

The program is comprised of a basic module and seven additional modules that can be used in any combination. The only restriction is that the basic module must always be included. There are nineteen possible decisions that can be included in the business game (if all modules are used together).

Included in Appendix A are examples of representative output reports to the students. There are three computer printouts included. These were actually played by high school students in class. Module configuration has been varied in each sample period. A program listing is included in Appendix B.

III. A. 3. Task III - Writing Instructions to Participants

There are nine components of these instructions. First, there is a set of general instructions that describes the environment and places the participants in their simulated situation. Second, there are instructions for the basic decision module that (1) explain the play of the game and the decisions that have to be made; (2) describe the reports that will be generated during the game; and (3) define the terms used in the reports. The other seven sets of instructions correspond to the seven modules. There is a set of instructions for the student to parallel each module that is introduced. For each module, these instructions explain the business concept introduced by the module and the changes in reports that will be caused by introduction of the module.

No effort has been made to tell participants what decisions are considered good decisions. Rather, each decision is described in terms of the information that might influence the making of that decision and the expected effects of decision alternatives. It is up to the teams to define their own competitive posture and make decisions that are appropriate to that posture (i.e., aggressive, follower, volume seller, quality seller, etc.)

Appendix C includes a copy of these instructions.

III. A. 4. Task IV - Testing Through Team Play

At this point in game development it became appropriate to test the simulator through actual play. We gratefully acknowledge the extensive participation of Lower Merion Senior High School in this effort.

In testing the game, we made an evaluation with respect to the following four questions:

(1) Stability of environment. Does the game remain stable in the face of inappropriate decisions, or does it degenerate into a series of extremes?

(2) Observable response. Does the environment respond to particular decisions in a manner consistent with accepted economic principles?

(3) Unrealistic tactics. Are there opportunities for "gaming" against the programmed environment in terms of making irrational decisions to exploit model imperfections?

(4) Decision difficulty. Is it, in fact, possible for high school level teams to arrive at justifiable decisions in a reasonable amount of time?

A senior economics class was recruited for the purpose of participating in the simulation experience. The class was an elective and it was felt, that because they were competent in basic economics, the class did not represent an average cross section of Lower Merion students. These students were, however, representative of those students taking economics.

No effort will be made here to justify the selection of Lower Merion except to say that it is an excellent high school in the Philadelphia area.

The schedule for this test administration is presented below:

(1) Seminar on game play and relevant micro-economic principles (1 hour). At this time we introduced the participants to the general nature of the game and its decisions. They were divided into teams and presented with instructions and a history consisting of three "prepared" periods. Questions were answered.

(2) Periods 4, 5, 6, and 7 (4 hours). Four periods were played on consecutive days. Teams met to receive output and consider their decisions. During this period of time, each team developed a set of "corporate" objectives and presented them to a group of faculty who simulated a board of directors. Modules 1, 2, and 3 were added to the basic module during periods 5, 6, and 7.

(3) Interim discussion (1 hour). All teams met in a seminar to discuss the progress of the industry to date. Particular attention was focused on micro-economic principles that had been observed ("discovered") by the players.

(4) Periods 7, 8, 9, 10, and 11 (5 hours). Teams again made decisions. During these periods, the decision set was further expanded beyond the basic decision module. Periods 10 and 11 included all decision modules. During period 9 a labor strike occurred in the industry. Labor productivity dropped to 50 percent and no hirings or firings could be undertaken.

(5) Wrap-up. A final seminar gave each team an opportunity to present the relevant merits and weaknesses of their strategies during the game play. The game administrator participated so as to add his insights regarding relative team play. Each participant was also given an opportunity to critique the general model and method of play.

During the proceedings at Lower Merion High School, records were kept and a questionnaire was filled out by student participants. A copy of the questionnaire, a summary of the answers to the questionnaire, and a letter from Mrs. E. R. Medkeff, the teacher of the senior economics class, are included in Appendix D.

III. A. 5. Task V - Documentation of Administrator Participation

The primary function of the game administrator is to monitor the flow of information between the various participating teams and the computer simulation. Since the programs are all run on a time-shared computer system, this function is made extremely easy. The administrator merely calls the computer using a remote terminal device and, once a connection has been established, requests the computer to execute the stored simulation.

The simulation program will then cause messages to be printed at the terminal. These messages will provide the administrator with detailed

instructions concerning the decisions needed from each team and the method for entering these decisions into the computer. Once all required data has been so entered, the computer will run the appropriate simulator modules and print each team's output at the administrator's terminal. The various history decks needed for future play are updated automatically and maintained on magnetic disk storage at the computer center. More detailed instructions for the operation of the computer are given in Appendix E.

Also in Appendix E is a copy of the "Administrator's Output". This output is printed after all team output has been received. Administrator output includes the following for each team in the simulated industry:

Market share percentage
Dollar sales volume
Gross margin as a percent of sales
Net margin as a percent of sales
Net margin as a percent of assets
Price charged during the last period
National advertising expenditures
Zone 1 advertising expenditures
Zone 2 advertising expenditures
Zone 3 advertising expenditures
Product development expenditures
Capacity in units of goods
Labor force in numbers of employees
Turnover of inventory
Debt to equity ratio

IV. A. COST ESTIMATES FOR RUNNING THE HIGH SCHOOL BUSINESS GAME

Before estimating the costs associated with running this simulator, it is worthwhile to briefly outline the basic cost categories attendent to time sharing. These categories are:

(1) Terminal connect charges. These charges accrue to the user from the moment he establishes contact with the computer until the moment he breaks that contact. Terminal connect charges range from $8 to $13 per hour with $10 as an average charge.

(2) Central processor charges. The user is charged a premium for that period of time during which the computer is dedicated to his job. Note the difference between this charge and terminal connect charge. The user is not charged for central processor time during periods of input/output, file creation, idle time, etc. Central processor charges vary from $2.50 per minute to 40 cents per second depending on the size and capabilities of the computer involved. As a general rule of thumb, figure that processor charges will run from twenty to seventy percent of connect charges with thirty percent being average.

(3) Storage charges. A charge of from $1 to $1.75 is made for every 1,000 characters of storage required to maintain your disk files. Often the first fifty to seventy-five thousand characters are stored free of charge.

(4) Charges for use of peripheral equipment. Often, there is a charge made for the use of such peripheral devices as card readers, card punches, or high speed printers. These fees are based on cards punched, lines printed, and so on.

(5) Secondary storage. A charge of $5 to $10 per month is usually made for each magnetic tape used as secondary storage.

(6) Terminal rental. Terminals can be rented from the various time sharing services or from independent agencies such as ITT. Depending on features, these units rent for $50 to $5,000 per month. A very adequate model (TTY 33 ASR) rents for approximately $90 per month.

The costs shown below reflect our experience during a period of development and testing. Undoubtedly, these figures can be reduced substantially once a careful cost study has been made and appropriate changes have been implemented. The following figures are based on a six team industry playing the maximum decision set.

Terminal connect time	40 min.	6.67
Central processor time	20 sec/20¢ per sec	4.00
Storage charges	100,000 char.	50.00/month
Tape rental	1	5.00/month

If a class of 36 (6 teams of 6 players) were to play three times per week for a period of one month, the total bill would be slightly more than $175. This figure can be substantially reduced by improving the running efficiency of the program, letting more than one school or more than one class use the program (thus allocating storage over more use), and considering the educational discount available to high schools.

V. A. FINDINGS

Since the basic objectives of the project were the design and development of a computer game, no hypotheses were established or tested. The findings, therefore, are descriptions of the feasibility and practicality of the design presented and the uses to be made of that design. The findings are divided into those that pertain to the simulation model and those that pertain to the administration of the business game.

V. A. 1. Findings Pertaining to the Computer Model

The business game designed, developed, and tested in this project is based on a model of oligopolistic competition. Price, product quality, marketing expenditures, and marketing research were all "competitive" decisions that determined levels of company sales. It was observed that in some respects the extremely competitive nature of the simulated environment detracted from the learning experience. Also, it appeared to be a traumatic experience for a high school team to lose a large amount of money as the result of a series of poor decisions. In short, the potential

spread between the performance of the companies (teams) over the play of the game was too high.

By basing the mathematical model on exponential functions instead of linear ones, the business game responds to decisions in a manner more consistent with accepted economic principles. This is because exponential functions demonstrate the law of diminishing marginal returns to resource application. Another advantage of exponential functions is that they make the game more "controllable". That is, price, advertising, and other decision spirals are not possible. These spirals were previously caused by the unjudicious use of a resource by all teams together. When such spirals occur, the learning value of the experience is detrimentally affected.

Even with exponential functions, it was found that the game was not as controllable as desired. Although the exponential functions and other facets of the mathematical model successfully deleted the opportunities for "gaming" against the simulator, the highly competitive nature of the marketing decisions has the ability of producing extreme variation in results. The sensitivity of results to these three decisions in the model is higher than desirable for mass, unmonitored use of the business game.

V. A. 2. Findings Pertaining to the Administration

A high degree of student involvement in the experience was achieved. Students tended to "discover" interesting economic phenomenon. Students were given a new impetus for the thorough understanding of relevant concepts, because without such clear understanding, they were put at an obvious competitive disadvantage. It was clear in the pilot test that it is possible for high school students to arrive at justifiable, rational decisions in a reasonable amount of time.

The module concept, whereby decisions and economic principles are added to a basic operating module in a step-wise fashion, proved to be extremely workable. By starting with a simple set of decisions, the introduction of the business game was made easier. Furthermore, since each new module represents a new business concept, the teaching of business principles is made easier by being able to explain one business concept at a time. Most students in the Lower Merion test group had little difficulty in mastering the play of the game.

Qualitative material, presented as "acts of God", represented major changes in the business environment (such as the labor strike presented in the test administration). These materials are especially stimulating. Another valuable feature was periodic board of directors meetings. It seems to be meaningful if outside faculty or staff are asked to sit in on these presentations as members of the simulated board of directors. Teams made a real effort to be well prepared for such meetings and many important questions were answered at this time. As a side-light the student-faculty communication channel opened in these presentations seemed to be a good one for generating a joint participation in a learning experience.

The administration of the game worked well by conducting classes on consecutive days for two weeks. It is felt that a more advantageous schedule is perhaps two or three times a week for an extended period of time. Most students indicated a preference for more time to work on decisions.

Before starting the test administration, it was determined that the students should be given some form of history on which to base their first decision. For this purpose, three periods were preplayed and students were given the output from these plays to use as background information. It was found that this was a necessary supplement to participant instructions and that three periods made an excellent foundation for future decisions.

The use of time sharing in administering the game proved both feasible and practical except for one problem. This problem is that schools traditionally have a minimum of telephone facilities. Time sharing either needs its own telephone line or must tie up an operating line for extended periods of time. It was found that for an industry of six teams, it takes ten minutes to input the decisions to the computer and thirty to forty minutes to print the results of the decisions. Both decision input and results output take place over a time sharing remote terminal.

VI. A. CONCLUSIONS AND RECOMMENDATIONS

VI. A. 1. Conclusions

It is concluded that:

(1) The use of a computerized business game in high school to teach business, accounting, and micro-economics is technically feasible.

(2) The module concept in simulation games is practical and is of definite pedagogical value.

(3) The "competitive" nature of simulation games does not have to be pronounced, and, in fact, is detrimental to the learning experience if it is over-emphasized.

(4) Time sharing offers a convenient means for the administration of computer games to high schools. Hardware needs of each school are minimal, and unlike any other means of administration, absolutely no support people are needed beyond the teacher.

VI. A. 2. Recommendations

It is recommended that:

(1) The business game model be redesigned somewhat to delete much of the competitive nature of the simulated market.

(2) A thorough investigation of the costs involved in administering a game be undertaken.

(3) An implementation system for the introduction of the business game and other such games to secondary schools be developed.

(4) The business game be established in more than one high school and an extended trial run be undertaken as a preliminary step toward offering the game nationwide.

[1413]

APPENDIX A

****

POSITION REPORTS
******** *******
****
FIRM 1 PERIOD 6

FIRM INTERNATIONL

INPUT DECISIONS
****

PRODUCTION	130000.	RAW MAT PURCHASES	121500.
EMPLOYEES HIRED	11.	EMPLOYEES FIRED	0.
NEW PLANT	30000.	PRICE	21.
EMERGENCY LOAN REPAYMENT	0.		
NATIONAL ADVERTISING	150000.		

INCOME STATEMENT
****

SALES	2104921.
COST OF GOODS SOLD	
BEG INVENTORY	0.
MANUFACTURING COSTS	1631736.
ENDING INVENTORY	416997.
COST OF GOODS SOLD	1214739.
GROSS MARGIN	890182.
OPERATING EXPENSES	
DEPRECIATION	52621.
TRANSPORTATION	15492.
WAREHOUSING	78150.
ADMINISTRATIVE	594956.
MARKETING	150000.
TOTAL	891219.
OPERATING INCOME	-1037.
OTHER EXPENSES	0.
INCOME BEFORE TAXES	-1037.
TAXES	-539.
NET INCOME	-498.
ADDITION TO NET WORTH	-498.

[413]

FUNDS STATEMENT
****

SOURCES	
SALES	2104921.
NEW LOANS	0.
TOTAL	2104921.
USES	
CASH FOR OPERATIONS	2440724.
TAXES	-539.
PLANT INVESTMENT	30000.
TOTAL	2470185.
ADDITION TO CASH ASSETS	-365264.

BALANCE SHEET
****

ASSETS	
CASH	465497.
INVENTORY	416997.
RAW MATERIALS	34835.
PLANT	999799.
TOTAL	1917127.
LIABILITIES	0.
NET WORTH	1917127.
TOTAL	1917127.

PRODUCTION AND SALES DATA IN UNITS

	BEG INV	SHIPMENTS	SALES	END INV
ZONE 1	0.	25419.	20059.	5360.
ZONE 2	0.	39329.	29318.	10011.
ZONE 3	0.	65251.	47401.	17850.
TOTALS	0.	130000.	96778.	33222.

MANUFACTURING COST DATA

RAW MATERIALS	452852.
LABOR	602000.
OVERHEAD	576884.
TOTAL	1631736.

RAW MATERIALS INVENTORY (IN UNITS)

BEG INVENTORY	18500.
PURCHASES	121500.
PRODUCTION	130000.
ENDING INVENTORY	10000.

LABOR REPORT

EMPLOYEES LAST PERIOD	134.
EMPLOYEES HIRED	11.
EMPLOYEES FIRED	0.
EMPLOYEES THIS PERIOD	145.

PLANT CAPACITY NEXT PERIOD	130490.
RAW MAT PRICE NEXT PERIOD	3.288
WAGE COST NEXT PERIOD	4150.23

1413

MARKETING INFORMATION

****

ECONOMIC INDEX THIS PERIOD	1.00
ECONOMIC FORECAST NEXT PERIOD	1.00
ECONOMIC FORECAST TWO PERIODS HENCE	0.97

ZONAL ECONOMIC FORECASTS

ZONE	1	2	3
THIS PERIOD	1.00	1.00	1.00
NEXT PERIOD	0.99	1.02	0.99
TWO PERIODS HENCE	1.04	1.02	0.91

MARKET SHARE (ESTIMATES)

FIRM 1	0.17
FIRM 2	0.22
FIRM 3	0.20
FIRM 4	0.21
FIRM 5	0.20

MARKETING EXPENDITURES (ESTIMATES)

FIRM	NATIONAL
1	150000.
2	78329.
3	105260.
4	150344.
5	90730.

NEWSLETTER

****

FIGURES EXPRESSED IN DOLLARS

FIRM	SALES	PROFIT	NEW PLANT	ASSETS	LOANS	PRICE
1	2104921.	-498.	30000.	1917127.	0.	21.75
2	2581545.	39122.	0.	1901371.	0.	20.35
3	2351529.	-11522.	0.	1927947.	0.	20.90
4	2452406.	16917.	0.	1874605.	0.	20.40
5	2387475.	19499.	50000.	1839521.	0.	20.25

****

POSITION REPORTS
******** *******
****
FIRM 1 PERIOD 7

FIRM INTERNATIONL

INPUT DECISIONS
****

PRODUCTION	87278.	RAW MAT PURCHASES	77278.
EMPLOYEES HIRED	0.	EMPLOYEES FIRED	10.
NEW PLANT	0.	PRICE	20.75
EMERGENCY LOAN REPAYMENT	0.		
SHIPMENTS TO ZONE 1	9000.		
SHIPMENTS TO ZONE 2	50000.		
SHIPMENTS TO ZONE 3	28278.		
NATIONAL ADVERTISING	50000.		
ZONE 1 ADVERTISING	15000.		
ZONE 2 ADVERTISING	60000.		
ZONE 3 ADVERTISING	25000.		

1413

INCOME STATEMENT
****

SALES	2231847.
COST OF GOODS SOLD	
BEG INVENTORY	416997.
MANUFACTURING COSTS	1249540.
ENDING INVENTORY	178978.
COST OF GOODS SOLD	1487558.
GROSS MARGIN	744289.
OPERATING EXPENSES	
DEPRECIATION	49990.
TRANSPORTATION	12700.
WAREHOUSING	67978.
ADMINISTRATIVE	482862.
MARKETING	150000.
TOTAL	763530.
OPERATING INCOME	-19241.
OTHER EXPENSES	0.
INCOME BEFORE TAXES	-19241.
TAXES	-10005.
NET INCOME	-9236.
ADDITION TO NET WORTH	-9236.

FUNDS STATEMENT
****

SOURCES	
SALES	2231847.
NEW LOANS	0.
TOTAL	2231847.
USES	
CASH FOR OPERATIONS	1930201.
TAXES	-10005.
PLANT INVESTMENT	0.
TOTAL	1920195.
ADDITION TO CASH ASSETS	311652.

BALANCE SHEET
****

ASSETS	
CASH	777149.
INVENTORY	178978.
RAW MATERIALS	0.
PLANT	949809.
TOTAL	1905936.
LIABILITIES	0.
NET WORTH	1905936.
TOTAL	1905936.

PRODUCTION AND SALES DATA IN UNITS

	BEG INV	SHIPMENTS	SALES	END INV
ZONE 1	5360.	9000.	14360.	0.
ZONE 2	10011.	50000.	47070.	12941.
ZONE 3	17850.	28278.	46128.	0.
TOTALS	33222.	87278.	107559.	12941.

MANUFACTURING COST DATA

RAW MATERIALS	286963.
LABOR	506000.
OVERHEAD	456577.
TOTAL	1249540.

RAW MATERIALS INVENTORY (IN UNITS)

BEG INVENTORY	10000.
PURCHASES	77278.
PRODUCTION	87278.
ENDING INVENTORY	0.

LABOR REPORT

EMPLOYEES LAST PERIOD	134.
EMPLOYEES HIRED	0.
EMPLOYEES FIRED	10.
EMPLOYEES THIS PERIOD	124.

PLANT CAPACITY NEXT PERIOD	132614.
RAW MAT PRICE NEXT PERIOD	3.171
WAGE COST NEXT PERIOD	4186.66

MARKETING INFORMATION

****

ECONOMIC INDEX THIS PERIOD	1.00
ECONOMIC FORECAST NEXT PERIOD	1.01
ECONOMIC FORECAST TWO PERIODS HENCE	0.99

ZONAL ECONOMIC FORECASTS

ZONE	1	2	3
THIS PERIOD	1.00	1.00	1.00
NEXT PERIOD	1.00	0.96	1.04
TWO PERIODS HENCE	1.01	0.95	1.01

MARKET SHARE (ESTIMATES)

FIRM 1	0.18
FIRM 2	0.22
FIRM 3	0.20
FIRM 4	0.22
FIRM 5	0.19

MARKETING EXPENDITURES (ESTIMATES)

FIRM	ZONE 1	ZONE 2	ZONE 3	NATIONAL
1	15000.	60000.	25000.	50000.
2	26497.	25537.	53545.	104735.
3	14875.	22076.	38024.	79302.
4	20094.	26799.	56497.	52169.
5	38667.	15813.	15619.	79555.

NEWSLETTER

****

FIGURES EXPRESSED IN DOLLARS

FIRM	SALES	PROFIT	NEW PLANT	ASSETS	LOANS	PRICE
1	2231847.	-9236.	0.	1905936.	0.	20.75
2	2649749.	64458.	100000.	1965731.	0.	20.10
3	2400723.	47332.	0.	1971250.	0.	20.40
4	2611695.	80596.	100000.	1954028.	0.	20.40
5	2439178.	64700.	0.	1904182.	0.	20.35

****

POSITION REPORTS
******** *******
****
FIRM 1 PERIOD 11

FIRM INTERNATIONL

INPUT DECISIONS
****

PRODUCTION	117234.	RAW MAT PURCHASES	117234.
EMPLOYEES HIRED	0.	EMPLOYEES FIRED	16.
NEW PLANT	0.	PRICE	20.05
EMERGENCY LOAN REPAYMENT	0.		
SHIPMENTS TO ZONE 1	30000.		
SHIPMENTS TO ZONE 2	30128.		
SHIPMENTS TO ZONE 3	57106.		
NATIONAL ADVERTISING	50000.		
ZONE 1 ADVERTISING	40000.		
ZONE 2 ADVERTISING	30000.		
ZONE 3 ADVERTISING	60000.		
PRODUCT DEVELOPMENT	15000.		
MAINTENANCE	40000.		
MARKET RESEARCH	15000.		
NEW LOANS	0.	DIVIDENDS PER SHARE	0.000
LOAN REPAYMENT	0.	INVESTMENT	375000.

INCOME STATEMENT

SALES	2482509.
COST OF GOODS SOLD	
BEG INVENTORY	182242.
MANUFACTURING COSTS	1495545.
ENDING INVENTORY	104019.
COST OF GOODS SOLD	1573768.
GROSS MARGIN	908741.
OPERATING EXPENSES	
DEPRECIATION	40717.
TRANSPORTATION	15026.
WAREHOUSING	77723.
ADMINISTRATIVE	490843.
MAINTENANCE	40000.
PRODUCT DEVELOPMENT	15000.
MARKETING	195000.
TOTAL	874308.
OPERATING INCOME	34433.
OTHER EXPENSES	0.
OTHER INCOME	9375.
INCOME BEFORE TAXES	43808.
TAXES	22780.
NET INCOME	21028.
DIVIDENDS	0.
ADDITION TO NET WORTH	21028.

FUNDS STATEMENT
****

SOURCES	
SALES	2482509.
NEW LOANS	0.
INVESTMENTS	9375.
TOTAL	2491884.
USES	
CASH FOR OPERATIONS	2329137.
TAXES	22780.
PLANT INVESTMENT	0.
DIVIDENDS	0.
LOAN REPAYMENT	0.
TOTAL	2351917.
ADDITION TO CASH ASSETS	139967.

BALANCE SHEET
****

ASSETS	
CASH	1041721.
INVENTORY	104019.
RAW MATERIALS	0.
PLANT	773625.
TOTAL	1919365.
LIABILITIES	0.
NET WORTH	1919365.
TOTAL	1919365.

PRODUCTION AND SALES DATA IN UNITS

	BEG INV	SHIPMENTS	SALES	END INV
ZONE 1	0.	30000.	25307.	4693.
ZONE 2	3872.	30128.	34000.	0.
ZONE 3	10894.	57106.	64509.	3490.
TOTALS	14766.	117234.	123816.	8184.

MANUFACTURING COST DATA

RAW MATERIALS	393376.
LABOR	587321.
OVERHEAD	514849.
TOTAL	1495545.

RAW MATERIALS INVENTORY (IN UNITS)

BEG INVENTORY	0.
PURCHASES	117234.
PRODUCTION	117234.
ENDING INVENTORY	0.

LABOR REPORT

EMPLOYEES LAST PERIOD	148.
EMPLOYEES HIRED	0.
EMPLOYEES FIRED	16.
EMPLOYEES THIS PERIOD	132.

PLANT CAPACITY NEXT PERIOD	131792.
RAW MAT PRICE NEXT PERIOD	3.407
WAGE COST NEXT PERIOD	4497.28

MARKETING INFORMATION

ECONOMIC INDEX THIS PERIOD	1.00
ECONOMIC FORECAST NEXT PERIOD	1.02
ECONOMIC FORECAST TWO PERIODS HENCE	1.01

ZONAL ECONOMIC FORECASTS

ZONE	1	2	3
THIS PERIOD	1.00	1.00	1.00
NEXT PERIOD	1.00	1.10	0.98
TWO PERIODS HENCE	0.96	0.99	1.05

MARKET SHARE (ESTIMATES)

FIRM 1	0.21
FIRM 2	0.25
FIRM 3	0.12
FIRM 4	0.21
FIRM 5	0.22

PRODUCT DEVELOPMENT (ESTIMATES)

FIRM 1	15000.00
FIRM 2	10086.91
FIRM 3	2945.19
FIRM 4	25186.26
FIRM 5	49378.69

MARKETING EXPENDITURES (ESTIMATES)

FIRM	ZONE 1	ZONE 2	ZONE 3	NATIONAL
1	40000.	30000.	60000.	50000.
2	41349.	34417.	75460.	154179.
3	5243.	10183.	18667.	15344.
4	29571.	41878.	61759.	50117.
5	46675.	30550.	31807.	81385.

NEWSLETTER

FIGURES EXPRESSED IN DOLLARS

FIRM	SALES	PROFIT	NEW PLANT	ASSETS	LOANS	PRICE
1	2482509.	21028.	0.	1919365.	0.	20.05
2	2806802.	-53635.	0.	1871989.	0.	19.25
3	1578985.	-232144.	0.	1805440.	141232.	22.00
4	2434413.	24303.	0.	1932703.	0.	20.25

5	2650613.	56404.	0.	2073991.	0.	20.07

HGSGME

```
      FILE  4=OUT2,UNIT=PRINTER
      FILE  5=IN,UNIT=REMOTE,BLOCKING=3,RECORD=10
      FILE  6=OUT,UNIT=REMOTE,BLOCKING=3,RECORD=10
      FILE  8=PRODAT,UNIT=DISK,BLOCKING=3,RECORD=20
      $TSSFDIT
            COMMON PLANT1(10),PLANT(10),RMIN1(10),RMINV(10),RMPUR(10),
           2EMPF(10),EMPL(10),EMPH(10),EMPL1(10),FLABOR(10),PROD(10),
           3PRDCAP(10),SHIP(3,10),PRICE(10),ADVNAT(10),PRDDEV(10),SUMADV(3),
           4ADV(3,10),FACADV(3),TOTPOT(3),      ECONZ(3,20),DMDPRI(10),
           5TIMADV(3,10),TIMPRI(10),TIMNAT(10),TIMDEV(10),DMDNAT(10),
           6DMDDEV(10),PERPRI(3,10),PERNAT(3,10),PERDEV(3,10),PERZON(3,10),
           7DEMAND(3,10),FACTOR(3),POTSAL(3,10),AVAIL(3,10),BINV(3,10),
           8TBINV(10),SALUNT(3,10),FINV(3,10),TINV(10),TSALES(10),TINVD(10),
           9RMCOST(10),SHIFTN(10),WAGES(10),OVHEAD(10),BVAL(10),CSTMFG(10)
            COMMON COSTUT(10),WORTH(10),VSALES(10),CSTGSD(10),GROSS(10),
           2        DEP(10),PLTLAT(10),TRANS(10),WARE(10),ADMS(10),MODUSE(7:
           3,FMAINT(10),TMKTG(10),FMKTRS(10),TEXP(10),OPINC(10),FINTIN(10),
           4RPY6(10),TLN6(10),FLNREQ(10),CSHOUT(10),CAVAIL(10),FLN20(10),
           5FINTPY(10),RPY20(10),TLN20(10),FINBT(10),TAX(10),FINAT(10),
           6DIVTOT(10),ADRE(10),TNEWLN(10),SOURCE(10),USE(10),TOTRPY(10),
           7ADCASH(10),CASH(10),RAWMAT(10),TLNTOT(10),ASSETS(10),FNETWT(10),
           8TLIAB(10),SHMKT(10),ESTEC1(10),ESTEC2(10),ESTZE1(3,10)
           9,ESTZE2(3,10),ESTNAT(10,10),ESTPRD(10,10),ESTSHR(10,10)
            COMMON ESTZON(3,10,10),SALES1(10)
            COMMON ADVMIN(3),SHSTG(10),PLNTIN(10),FINVBD(10),DIVPSH(10),
           2DMDADV(3,10),TMNAME(10,2),PRFACT(10),TOTADV(3)
            DIMENSION ZWT(3),IPRNT(10),CPERC(3),CONE(3),CFOR(4)
            COMMON FLNPAY(10)
            COMMON GMARG(6),PRPER(6),PERASS(6),TURN(6),DTRAT(6)
            DATA CPERC/.3,1.3,1.75/,CONE/.20,1.75,.03/,CFOR/.05,.02,1.75,.005/
            DATA ZWT/.20,.30,.50/
            DATA (ECONZ(1,I),I=1,10)/1,1,1,.97,.95,.98,1,1.02,1.05,1.08/
            DATA (ECONZ(2,I),I=1,10)/1,1,1,.99,.97,1,1,1.04,1.06,1.08/
            DATA (ECONZ(3,I),I=1,10)/1,1,1,.95,.93,.91,.97,.99,1,1.02/
            INTEGER P,B,Q
            FLNLIM=500000.
            DO 1580 K=1,10
      1580  SHSTG(K)=150000.
            HIST=.5
            ANTMIN=.050
            DO 3715 J=1,3
      3715  ADVMIN(J)=.03
            PRDMIN=.02
            DEPLET=.05
            RESMIN=10000.
            RLNMIN=0.0
            RLNPAY=0.0
            DIVMIN=.25
            FINMIN=0.
            COSTRM=3.50
            WAGE=3500.
            PLTNOW=.20
            PLTUNT=10.000
```

```
      PRODLB=900.
      CFIRE=2000.
      CHIRE=1000.
      CRMINV=.20
      CSHMIN=1.000
      CSHDIV=2.0
      CSHIFT=.30
      DEPRAT=.05
      CSHP1=.30
      CSHP2=.20
      CHSP3=.40
      CWHAR=1.00
      DORIG=3100000.;ADMIN=200000.;OMIN=180000.;A1=1.0;A2=1.0
      A3=400.;F1=1.75;F2=500.;F3=.50
      FINT=.025
      FINT1=.035
      FINT2=.10
      TAXR=.52
      CDELT=.40
      PDET=.95
      DETSHT=.25
      WDELT=.20
      WRITE(6,98)
   98 FORMAT(///"PRODUCTION MANAGEMENT SIMULATOR"/
     2"**********************************"/
     3"**********************************"///)
      Q=6
      WRITE(6,7359)
 7359 FORMAT(///"INPUT A RANDOM START     (5-7 CHARACTERS AND ODD)")
      READ(5,/)NSTART
      ZZZ=RANDOM(NSTART);ZZZ=RANDOM(0)
      WRITE(6,2400)
 2400 FORMAT(///"INPUT 7 MODULE CODES  (1 IF TEAMS DONT PLAY)")
      READ(5,/)(MODUSE(N),N=1,7)
   84 FORMAT(A3)
      P=8
       WRITE(6,865)
  865 FORMAT(///"IS THIS PERIOD ONE  (YES OR NO)")
      READ(5,84)ATEST;IF(ATEST.EQ."YES")NPD=1
      IF(NPD.NE.1)GO TO 868
      WRITE(6,869)
  869 FORMAT(///"INPUT NUMBER OF TEAMS TO PLAY");READ(5,/)NFIRM
      DO 8110 K=1,NFIRM;WRITE(6,8112)K
 8112 FORMAT(///"INPUT NAME FOR TEAM ",I4)
 8110 READ(5,8114)(TMNAME(K,N),N=1,2)
 8114 FORMAT(2A6)
 1520 FORMAT(///" THERE HAVE BEEN SOME MISUNDERSTANDINGS WITH"/
     2" THE LOCAL LABOR UNION REPRESENTING YOUR PLANT WORKERS."/
     3" IT IS ESTIMATED THAT YOU WILL LOOSE FIFTY PERCENT OF"/
     4" YOUR LABOR PRODUCTIVITY IN PERIOD 9.")
  868 IF(NPD.EQ.1)GO TO 8145
      READ(P)WAGE,COSTRM,NPD,NFIRM
      DO 1041 K=1,10;DO 1041 N=1,2
 1041 READ(P)TMNAME(K,N)
      DO 510 K=1,10
  510 READ(P)RMINV(K),PRDCAP(K),PLTLAT(K),EMPL(K),TIMNAT(K),
     2TIMDEV(K),(TIMADV(J,K),J=1,3),TIMPRI(K),WORTH(K),(BINV(J,K),
```

```
     3J=1,3),PLANT(K),TLN6(K),TLN20(K),CASH(K),SALAVG  ,SALES1(K)
      WRITE(6,1091)NPD,((TMNAME(K,N),N=1,2),K=1,NFIRM)
1091 FORMAT(///"WELCOME TO PERIOD",I4/"TEAMS ARE"/10(/2A6))
8145 CONTINUE
1515 FORMAT(///"HOW MANY COPIES OF OUTPUT ARE DESIRED")
      IF(NPD.NE.1)GO TO 8350;DO 8351 K=1,NFIRM;RMINV(K)=10000.
      PRDCAP(K)=100000.;EMPL(K)=117.;TIMNAT(K)=50000.;
      TIMDEV(K)=30000.;TIMADV(1,K)=25000.;TIMADV(2,K)=25000.;
      TIMADV(3,K)=25000.;BINV(1,K)=2000.;TIMPRI(K)=20.;
      BINV(2,K)=3000.;BINV(3,K)=5000.;WORTH(K)=10.;
      PLANT(K)=1000000.;CASH(K)=500000.;SALAVG=2000000.
      SALES1(K)=2000000.
8351 CONTINUE
8350 CONTINUE
      IF(NPD.EQ.9)PRODLB=450.
      DO 2221 K=1,NFIRM
2221 TSOLD1=TSOLD1+SALES1(K)
C     READ TEAM RESPONSES
      DO 2450 K=1,NFIRM
      WRITE(6,2401)K
2401 FORMAT(///"TEAM",I4)
2421 FORMAT("  PRODUCTION VOLUME"/"  PRICE"/"  EMPLOYEES HIRED"/
     2"  EMPLOYEES FIRED"/"  RAW MATERIALS PURCHASED"/
     3"  NEW PLANT"/"  REPAYMENT OF 20% LOAN")
      READ(5,/)PROD(K),PRICE(K),EMPH(K),EMPF(K),RMPUR(K),PLNTIN(K)
     2,RPY20(K)
      IF(MODUSE(1).EQ.1)GO TO 2402
      WRITE(6,2420)
2420 FORMAT(///"  SHIPMENTS TO ZONE 1"/"  SHIPMENTS TO ZONE 2")
      READ(5,/)SHIP(1,K),SHIP(2,K)
2402 IF(MODUSE(2).EQ.1)GO TO 2403
      WRITE(6,2035)
2035 FORMAT(///"  NATIONAL ADVERTISING")
      READ(5,/)ADVNAT(K)
2403 IF(MODUSE(3).EQ.1)GO TO 2404
      WRITE(6,2036)
2036 FORMAT(///"  ZONE 1 ADVERTISING"/"  ZONE 2 ADVERTISING"/
     2"  ZONE 3 ADVERTISING")
      READ(5,/)(ADV(J,K),J=1,3)
2404 IF(MODUSE(4).EQ.1)GO TO 2405
      WRITE(6,2037)
2037 FORMAT(///"  PRODUCT DEVELOPMENT")
      READ(5,/)PRODEV(K)
2405 IF(MODUSE(5).EQ.1)GO TO 2406
      WRITE(6,2038)
2038 FORMAT(///"  MAINTENANCE EXPENDITURE")
      READ(5,/)FMAINT(K)
2406 IF(MODUSE(6).EQ.1)GO TO 2407
      WRITE(6,2039)
2039 FORMAT(///"  MARKET RESEARCH")
      READ(5,/)FMKTRS(K)
2407 IF(MODUSE(7).EQ.1)GO TO 2408
      WRITE(6,2041)
2041 FORMAT(///"  REPAYMENT OF 6% LOAN"/
     2"  INVESTMENT IN BONDS"/"  6% LOAN REQUESTED"/"  DIVIDEND ")
      READ(5,/)RPY6(K),FINVBD(K),FLNREQ(K),DIVPSH(K)
2408 CONTINUE
```

```
 2450 CONTINUE
C         ROUTINE TO REDUCE REPAYMENTS TO NO MORE THAN LOANS OSTG
      DO 1382 K=1,NFIRM;IF(RPY6(K).GT.TLN6(K))RPY6(K)=TLN6(K)
      IF(RPY20(K).GT.TLN20(K))RPY20(K)=TLN20(K)
 1382 CONTINUE
C
C     REDUCE PRODUCTION TO MAXIMUM LIMITS
C
      DO 90 K=1,NFIRM
      PLANT1(K)=PLANT(K)
      RMIN1(K)=RMINV(K)
      RMINV(K)=RMINV(K)+RMPUR(K)
      IF(EMPF(K).GT.EMPL(K)+EMPH(K))EMPF(K)=EMPL(K)+EMPH(K)
      EMPL1(K)=EMPL(K)
      EMPL(K)=EMPL(K)+EMPH(K)-EMPF(K)
      FLABOR(K)=EMPL(K)*PRODLB
      IF(PROD(K).GT.RMINV(K))PROD(K)=RMINV(K)
      IF(PROD(K).GT.1.0*PRDCAP(K))PROD(K)=1.0*PRDCAP(K)
      IF(PROD(K).GT.FLABOR(K))PROD(K)=FLABOR(K)
      IF(PROD(K).LT.0.0)PROD(K)=0.0
   90 CONTINUE
      DO 1695 K=1,NFIRM
      IF(FLNREQ(K)+TLN6(K).GT.FLNLIM)FLNREQ(K)=FLNLIM-TLN6(K)
 1695 CONTINUE
C
C     GENERATE DEFAULT INPUT VALUES FOR FIRM RESPONSES
C
      NSTART=999
      IF(MODUSE(1).EQ.0)GO TO 800
C
C     DEFAULT ROUTINE TO GENERATE SHIPMENTS
C
      DO 50 K=1,NFIRM
      CALL GAUSS(NSTART,.03,1.00,X)
      SHIP(1,K)=PROD(K)*ZWT(1)*X
      CALL GAUSS(NSTART,.03,1.00,X)
   50 SHIP(2,K)=PROD(K)*ZWT(2)*X
  800 IF(MODUSE(2).EQ.0)GO TO 801
C
C     DEFAULT ROUTINE TO GENERATE NATIONAL ADVERTISING
C
      DO 51 K=1,NFIRM
      CALL GAUSS(NSTART,.03,1.00,X)
   51 ADVNAT(K)=SALAVG*ANTMIN*X
  801 IF(MODUSE(3).EQ.0)GO TO 802
C
C     DEFAULT ROUTINE TO GENERATE ZONAL MARKETING EFFORT
C
      DO 52 K=1,NFIRM
      DO 52 J=1,3
      CALL GAUSS(NSTART,.03,1.00,X)
   52 ADV(J,K)=SALAVG*.03*X*ZWT(J)
  802 IF(MODUSE(4).EQ.0)GO TO 803
C
C     DEFAULT ROUTINE TO GENERATE PRODUCT DEVELOPMENT
C
      DO 53 K=1,NFIRM
```

```
      CALL GAUSS(NSTART,.03,1.00,X)
   53 PRODEV(K)=SALAVG*PRDMIN*X
  803 IF(MODUSE(5).EQ.0)GO TO 804
C
C     DEFAULT ROUTINE TO GENERATE PLANT MAINTAINANCE
C
      DO 54 K=1,NFIRM
      CALL GAUSS(NSTART,.03,1.00,X)
   54 FMAINT(K)=0.0
  804 IF(MODUSE(6).EQ.0)GO TO 805
C
C     DEFAULT ROUTINE TO GENERATE MARKETING RESEARCH
C
      DO 55 K=1,NFIRM
      CALL GAUSS(NSTART,.03,1.00,X)
   55 FMKTRS(K)=RESMIN*X
  805 IF(MODUSE(7).EQ.0)GO TO 806
C
C     DEFAULT ROUTINE TO GENERATE FINANCIAL DATA
C
      DO 56 K=1,NFIRM
      RPY6(K)=TLN6(K)
      RPY20(K)=TLN20(K)
      FLNREQ(K)=0.0
      FINVBD(K)=0.0
      DIVPSH(K)=0.0
   56 CONTINUE
  806 CONTINUE
      TSAL1=FLOAT(NFIRM)*SALAVG
      DO 736 K=1,NFIRM
      SHIP(3,K)=PROD(K)-SHIP(1,K)-SHIP(2,K)
      IF(SHIP(3,K).GE.0.0)GO TO 736
      TSHIP=SHIP(1,K)+SHIP(2,K)
      SHIP(1,K)=(SHIP(1,K)/TSHIP)*PROD(K)
      SHIP(2,K)=(SHIP(2,K)/TSHIP)*PROD(K)
      SHIP(3,K)=0.0
  736 CONTINUE
      ECON=0.0
      ECON6=0.0
      ECON12=0.0
      DO 240 J=1,3
      ECON=ECON+ZWT(J)*ECONZ(J,NPD)
      ECON6=ECON6+ZWT(J)*ECONZ(J,NPD+1)
  240 ECON12=ECON12+ZWT(J)*ECONZ(J,NPD+2)
C
C     DETERMINE TOTAL DEMAND BASED ON UNITARY ELASTICITY WITH RESPECT TO
C
      SUMPRI=0.0
      DO 60 K=1,NFIRM
   60 SUMPRI=SUMPRI+PRICE(K)
      AVGPRI=SUMPRI/FLOAT(NFIRM)
      TOTDMD=DORIG*FLOAT(NFIRM)/AVGPRI*ECON
      WRITE(6,6001)TOTDMD
 6001 FORMAT(///"TOTDMD",F25.0)
C
C     ADJUST TOTAL DEMAND TO REFLECT TEAM RESPONSES IN AGGREGATE
C
```

```
      SUMNAT=0.0
      SUMDEV=0.0
      DO 241 J=1,3
  241 SUMADV(J)=0.0
      DO 61 K=1,NFIRM
      SUMNAT=SUMNAT+ADVNAT(K)*HIST+TIMNAT(K)*(1.0-HIST)
      SUMDEV=SUMDEV+PRDDEV(K)*HIST+TIMDEV(K)*(1.0-HIST)
      SUMNAT=SUMNAT/FLOAT(NFIRM)
      SUMDEV=SUMDEV/FLOAT(NFIRM)
      DO 61 J=1,3
      SUMADV(J)=SUMADV(J)+ADV(J,K)*HIST+TIMADV(J,K)*(1.-HIST)
   61 SUMADV(J)=SUMADV(J)/FLOAT(NFIRM)
      FACNAT=EXPON2(CONE,SUMNAT,SALAVG)
      FACDEV=EXPON2(CONE,SUMDEV,SALAVG)
      DO 120 J=1,3
  120 FACADV(J)=EXPON2(CONE,SUMADV(J),SALAVG)
      IF(MODUSE(2).EQ.0)TOTDMD=TOTDMD*FACNAT
      IF(MODUSE(4).EQ.0)TOTDMD=TOTDMD*FACDEV
      DO 121 J=1,3
      CALL GAUSS(NSTART,.03,1.00,X)
      TOTPOT(J)=TOTDMD*ZNT(J)*ECONZ(J,NPD)*X
      IF(MODUSE(3).EQ.0)TOTPOT(J)=TOTPOT(J)*FACADV(J)
  121 CONTINUE
      WRITE(6,6002)(TOTPOT(J),J=1,3)
 6002 FORMAT(///"TOTPOT",3F15.0)
C
C     ALLOCATE TOTAL DEMAND TO VARIOUS FIRMS
C
      DO 65 K=1,NFIRM
      DMDPRI(K)=PRICE(K)*HIST+TIMPRI(K)*(1.0-HIST)
      DMDNAT(K)=ADVNAT(K)*HIST+TIMNAT(K)*(1.0-HIST)
      DMDDEV(K)=PRDDEV(K)*HIST+TIMDEV(K)*(1.0-HIST)
      DO 65 J=1,3
   65 DMDADV(J,K)=ADV(J,K)*HIST+TIMADV(J,K)*(1.0-HIST)
      TOTPRI=0.0
      TOTNAT=0.0
      TOTDEV=0.0
      DO 242 J=1,3
  242 TOTADV(J)=0.0
      FMAXI=DMDPRI(1)
      DO 2821 K=1,NFIRM;IF(DMDPRI(K).GT.FMAXI)FMAXI=DMDPRI(K)
 2821 CONTINUE;DO 2822 K=1,NFIRM
 2822 PRFACT(K)=(FMAXI-DMDPRI(K)+1.0)**3.0
      DO 66 K=1,NFIRM
      TOTPRI=TOTPRI+PRFACT(K)
      TOTNAT=TOTNAT+DMDNAT(K)
      TOTDEV=TOTDEV+DMDDEV(K)
      DO 66 J=1,3
   66 TOTADV(J)=TOTADV(J)+DMDADV(J,K)
      DO 67 K=1,NFIRM
      DO 67 J=1,3
      PERPRI(J,K)=EXPON(NFIRM,.4,5.50,PRFACT(K),TOTPRI)
      PERNAT(J,K)=EXPON(NFIRM,.3,2.5,DMDNAT(K),TOTNAT)
      PERDEV(J,K)=EXPON(NFIRM,.3,2.8,DMDDEV(K),TOTDEV)
      PERZON(J,K)=EXPON(NFIRM,.3,2.250,DMDADV(J,K),TOTADV(J))
   67 CONTINUE
      DO 122 K=1,NFIRM
```

```
      DO 122 J=1,3
      DEMAND(J,K)=PERPRI(J,K)+PERNAT(J,K)
      IF(MODUSE(4).EQ.0)DEMAND(J,K)=DEMAND(J,K)+PERDEV(J,K)
      IF(MODUSE(3).EQ.0)DEMAND(J,K)=DEMAND(J,K)+PERZON(J,K)
  122 CONTINUE
      WRITE(6,6004)((DEMAND(J,K),J=1,3),K=1,NFIRM)
 6004 FORMAT(///"DEMAND",3F10.4)
      DO 243 J=1,3
  243 FACTOR(J)=0.0
      DO 68 K=1,NFIRM
      DO 68 J=1,3
   68 FACTOR(J)=FACTOR(J)+DEMAND(J,K)
      DO 69 K=1,NFIRM
      DO 69 J=1,3
      CALL GAUSS(NSTART,.01,1.00,X)
   69 POTSAL(J,K)=(DEMAND(J,K)/FACTOR(J))*TOTPOT(J)*X
      WRITE(6,6005)((POTSAL(J,K),J=1,3),K=1,NFIRM)
 6005 FORMAT(///"POTSAL",3F12.0)
C
C     DETERMINE ACTUAL UNIT SALES BY ZONE
C
      DO 200 K=1,NFIRM
      RMINV(K)=RMINV(K)-PROD(K)
      DO 200 J=1,3
      AVAIL(J,K)=SHIP(J,K)+BINV(J,K)
      TBINV(K)=TBINV(K)+BINV(J,K)
      SALUNT(J,K)=POTSAL(J,K)
      IF(SALUNT(J,K).GT.AVAIL(J,K))SALUNT(J,K)=AVAIL(J,K)
      FINV(J,K)=AVAIL(J,K)-SALUNT(J,K)
      TINV(K)=TINV(K)+FINV(J,K)
      TSALES(K)=TSALES(K)+SALUNT(J,K)
  200 CONTINUE
      WRITE(6,1702)(TSALES(K),K=1,NFIRM)
 1702 FORMAT(/" TSALES",5F10.0)
C
C     DETERMINE RM COST, WAGES, AND OVERHEAD
C
      DO 91 K=1,NFIRM
      RMCOST(K)=PROD(K)*COSTRM
      SHIFTN(K)=PROD(K)/PRDCAP(K)
      WAGES(K)=EMPL(K)*WAGE+EMPH(K)*2000.+EMPF(K)*1000.
      IF(MPD.EQ.9)WAGES(K)=WAGES(K)/2.
      CALL GAUSS(NSTART,.005,1.0,X)
   91 OVHEAD(K)=(OMIN+F1*PROD(K)+F2*EMPL(K)+F3*PRDCAP(K))*X
C
C     ROUTINE TO DETERMINE INVENTORY VALUATION
C
      DO 92 K=1,NFIRM
      BVAL(K)=WORTH(K)*TBINV(K)
      CSTMFG(K)=RMCOST(K)+WAGES(K)+OVHEAD(K)
      COSTUT(K)=CSTMFG(K)/PROD(K)
   92 WORTH(K)=(PROD(K)*COSTUT(K)+BVAL(K))/(PROD(K)+TBINV(K))
      DO 796 K=1,NFIRM
  796 TINVD(K)=TINV(K)*WORTH(K)
      DO 201 K=1,NFIRM
C
C     INCOME STATEMENT ITEMS
```

```
C
      VSALES(K)=TSALES(K)*PRICE(K)
      CSTGSD(K)=BVAL(K)+CSTMFG(K)-TINVD(K)
      GROSS(K)=VSALES(K)-CSTGSD(K)
      PLANT(K)=PLANT(K)+PLNTIN(K)
      DEP(K)=PLANT(K)*DEPRAT
      PLANT(K)=PLANT(K)-DEP(K)
      TRANS(K)=SHIP(1,K)*CSHP1 +SHIP(2,K)*CSHP2 +SHIP(3,K)*CSHP3
C         ROUTINE TO ADJUST ADMINISTRATIVE EXPENSE TO REFLECT MODULES
      WARE(K)=CWHAR*(TINV(K)+TSALES(K))/2.0+
     2(RMINV(K)+RMPUR(K))/2.0*CRMINV
      CALL GAUSS(NSTART,.005,1.0,X)
      ADMS(K)=(ADMIN+A1*TSALES(K)+A2*PROD(K)+A3*EMPL(K))*X
      IF(MODUSE(2).EQ.1)ADMS(K)=ADMS(K)+ADVNAT(K)
      IF(MODUSE(3).EQ.1)ADMS(K)=ADMS(K)+ADV(1,K)+ADV(2,K)+ADV(3,K)
      IF(MODUSE(4).EQ.1)ADMS(K)=ADMS(K)+PRODEV(K)
      IF(MODUSE(2).EQ.1)ADVNAT(K)=0.0
      IF(MODUSE(3).NE.1)GO TO 3479
      ADV(1,K)=0.;ADV(2,K)=0.;ADV(3,K)=0.
 3479 CONTINUE
      IF(MODUSE(4).EQ.1)PRODEV(K)=0.0
      TMKTG(K)=0.0
      IF(MODUSE(2).EQ.0)TMKTG(K)=TMKTG(K)+ADVNAT(K)
      IF(MODUSE(3).EQ.0)TMKTG(K)=TMKTG(K)+ADV(1,K)+ADV(2,K)+ADV(3,K)
      IF(MODUSE(6).EQ.0)TMKTG(K)=TMKTG(K)+FMKTRS(K)
      TEXP(K)=DEP(K)+FMAINT(K)+TRANS(K)+WARE(K)+ADMS(K)+TMKTG(K)+
     2PRODEV(K)
      OPINC(K)=GROSS(K)-TEXP(K)
      FINTIN(K)=FINVBD(K)*FINT
      IF(RPY6(K).GT.TLN6(K))RPY6(K)=TLN6(K)
      TLN6(K)=TLN6(K)-RPY6(K)+FLNREQ(K)
C
C     DETERMINE NECESSITY OF 20% LOAN
C
      CSHOUT(K)=FMAINT(K)+TRANS(K)+WARE(K)+ADMS(K)+TMKTG(K)+PRODEV(K)+
     2RMPUR(K)*CONSTRM+WAGES(K)+OVHEAD(K)
      CAVAIL(K)=CASH(K)+FLNREQ(K)-FINVBD(K)+VSALES(K)
     2-RPY6(K)-RPY20(K)
      IF(CSHOUT(K).GT.CAVAIL(K))FLN20(K)=CSHOUT(K)-CAVAIL(K)
      FLN20(K)=FLN20(K)/2.0
      TLN20(K)=TLN20(K)+FLN20(K)-RPY20(K)
      FINTPY(K)=TLN6(K)*FINT1+TLN20(K)*FINT2
      IF(RPY20(K).GT.TLN20(K))RPY20(K)=TLN20(K)
      FINBT(K)=OPINC(K)+FINTIN(K)-FINTPY(K)
      TAX(K)=TAXR*FINBT(K)
      FINAT(K)=FINBT(K)-TAX(K)
      DIVTOT(K)=DIVPSH(K)*SHSTG(K)
      ADRE(K)=FINAT(K)-DIVTOT(K)
C
C     FUNDS STATEMENT ITEMS
C
      TNEWLN(K)=FLNREQ(K)+FLN20(K)
      SOURCE(K)=VSALES(K)+FINTIN(K)+TNEWLN(K)
      USE(K)=CSHOUT(K)+TAX(K)+DIVTOT(K)+RPY6(K)+RPY20(K)+PLNTIN(K)
      TOTRPY(K)=RPY6(K)+RPY20(K)
      ADCASH(K)=SOURCE(K)-USE(K)
C
```

```
C       BALANCE SHEET ITEMS
C
        CASH(K)=CASH(K)+ADCASH(K)
        RAWMAT(K)=RMINV(K)*COSTRM
        TLNTOT(K)=TLN6(K)+TLN20(K)
        ASSETS(K)=CASH(K)+TINVD(K)+RAWMAT(K)+PLANT(K)
        FNETWT(K)=ASSETS(K)-TLNTOT(K)
        TLIAB(K)=FNETWT(K)+TLNTOT(K)
  201   CONTINUE
        WRITE(6,1703)(FINAT(K),K=1,NFIRM)
 1703   FORMAT(" FINAT",5F10.0)
C
C       DETERMINE MARKET SHARE
C
        DO 202 K=1,NFIRM
  202   TSOLD=TSOLD+TSALES(K)
        DO 203 K=1,NFIRM
  203   SHMKT(K)=TSALES(K)/TSOLD
        TSOLD=0.0
        DO 2478 K=1,NFIRM
 2478   TSOLD=TSOLD+VSALES(K)
C
C       MARKETING INFORMATION
        AM=1.0
        DO 210 K=1,NFIRM
        VAR=EXPON1(CFOR,FMKTRS(K),SALES1(K))
        DO 215 J=1,3
        CALL GAUSS(NSTART,VAR,AM,X)
        ESTZE1(J,K)=ECONZ(J,NPD+1)*X
        CALL GAUSS(NSTART,VAR,AM,X)
        ESTZE2(J,K)=ECONZ(J,NPD+2)*X
        ESTEC1(K)=ESTEC1(K)+ESTZE1(J,K)*ZWT(J)
  215   ESTEC2(K)=ESTEC2(K)+ESTZE2(J,K)*ZWT(J)
        DO 211 M=1,NFIRM
        CALL GAUSS(NSTART,VAR,AM,X)
        ESTNAT(K,M)=ADVNAT(M)*X
        IF(K.EQ.M)ESTNAT(K,M)=ADVNAT(M)
        CALL GAUSS(NSTART,VAR,AM,X)
        ESTPRD(K,M)=PRDDEV(M)*X
        IF(K.EQ.M)ESTPRD(K,M)=PRDDEV(M)
        CALL GAUSS(NSTART,VAR,AM,X)
        ESTSHR(K,M)=SHMKT(M)*X
        IF(K.EQ.M)ESTSHR(K,M)= SHMKT(M)
        DO 211 J=1,3
        CALL GAUSS(NSTART,VAR,AM,X)
        ESTZON(J,K,M)=ADV(J,M)*X
  211   IF(K.EQ.M)ESTZON(J,K,M)=ADV(J,M)
        TOTAL=0.0
        DO 212 M=1,NFIRM
  212   TOTAL=TOTAL+ESTSHR(K,M)
        DO 213 M=1,NFIRM
  213   ESTSHR(K,M)=ESTSHR(K,M)/TOTAL
  210   CONTINUE
C
C       HISTORY UPDATE
C
        DO 837 K=1,NFIRM
```

```
      PSAVE=PRDCAP(K)
      IF(MODUSE(5).EQ.1)FMAINT(K)=PRDCAP(K)*DEPLET*8.0
      PRDCAP(K)=PRDCAP(K)*PDET+FMAINT(K)/8.
      IF(PRDCAP(K).GT.PSAVE)PRDCAP(K)=PSAVE
      PRDCAP(K)=PRDCAP(K)+PLTNOW*PLNTIN(K)/PLTUNT+PLTLAT(K)/PLTUNT
      PLTLAT(K)=PLNTIN(K)*(1.0-PLTNOW)
  837 CONTINUE
      WAGE=WAGE*(1.0+WDELT*(TSOLD-TSOLD1)/TSOLD1)*ECON6
      CALL GAUSS(NSTART,.03,1.0,X)
      COSTRM=COSTRM*ECON*X
      TSOLD1=TSOLD
      WRITE(6,1700)
 1700 FORMAT(///"DO YOU WANT OUTPUT  (YES OR NO)")
      READ(5,84)ATEST;IF(ATEST.EQ."NO ")GO TO 1701
      IF(Q.EQ.4)WRITE(Q,6666)
 6666 FORMAT(1H1)
      WRITE(Q,99)
   99 FORMAT(/////50("*")//////)
      WRITE(Q,990)
  990 FORMAT(///,10X,"STUDENT INPUTS INCLUDE"/15X,
     2"THE BASIC DECISION MODULE")
      IF(MODUSE(1).EQ.0)WRITE(Q,661)
      IF(MODUSE(2).EQ.0)WRITE(Q,62)
      IF(MODUSE(3).EQ.0)WRITE(Q,63)
      IF(MODUSE(4).EQ.0)WRITE(Q,64)
      IF(MODUSE(5).EQ.0)WRITE(Q,665)
      IF(MODUSE(6).EQ.0)WRITE(Q,666)
      IF(MODUSE(7).EQ.0)WRITE(Q,667)
  661 FORMAT(15X,"MODULE ONE"/20X,"SHIPMENTS TO ZONES")
   62 FORMAT(15X,"MODULE TWO"/20X,"NATIONAL ADVERTISING")
   63 FORMAT(15X,"MODULE THREE"/20X,"ZONAL ADVERTISING")
   64  FORMAT(15X,"MODULE FOUR"/20X,"PRODUCT DEVELOPMENT")
  665 FORMAT(15X,"MODULE FIVE"/20X,"MAINTENANCE")
  666 FORMAT(15X,"MODULE SIX"/20X,"MARKET RESEARCH")
  667 FORMAT(15X,"MODULE SEVEN"/20X,"LOAN REPAYMENT"/
     220X,"INVESTMENT IN BONDS"/20X,"DIVIDENDS PER SHARE")
      WRITE(6,1515);READ(5,/)NCOPY
      DO 891 K=1,NFIRM;DO 891 MMM=1,NCOPY
      IF(Q.EQ.4)WRITE(Q,6666)
      WRITE(Q,99)
      WRITE(Q,842)K,NPD,(TMNAME(K,N),N=1,2)
  842 FORMAT(/////10X,"POSITION REPORTS"/10X,"******** ********"/
     210X,"****************"/10X,"FIRM",I3," PERIOD",I3//
     310X,"FIRM ",2A6)
      WRITE(Q,680)PROD(K),RMPUR(K),EMPH(K),EMPF(K),PLNTIN(K),PRICE(K)
     2,RPY20(K)
  680 FORMAT(//10X,"INPUT DECISIONS"/10X,"****************"//
     2" PRODUCTION",14X,F10.0,
     2" RAW MAT PURCHASES",7X,F10.0/" EMPLOYEES HIRED",9X,F10.0,
     3" EMPLOYEES FIRED",9X,F10.0/" NEW PLANT",15X,F10.0," PRICE",21X,
     4F10.2/" EMERGENCY LOAN REPAYMENT",F10.0)
      IF(MODUSE(1).EQ.0)WRITE(Q,681)(J,SHIP(J,K),J=1,3)
  681 FORMAT(" SHIPMENTS TO ZONE",I2,5X,F10.0)
      IF(MODUSE(2).EQ.0)WRITE(Q,3)ADVNAT(K)
    3 FORMAT(" NATIONAL ADVERTISING",4X,F10.0)
      IF(MODUSE(3).EQ.0)WRITE(Q,4)(J,ADV(J,K),J=1,3)
    4 FORMAT(" ZONE",I2," ADVERTISING",6X,F10.0)
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      IF(MODUSE(4).EQ.0)WRITE(Q,5)PRDDEV(K)
    5 FORMAT(" PRODUCT DEVELOPMENT",5X,F10.0)
      IF(MODUSE(5).EQ.0)WRITE(Q,6)FMAINT(K)
    6 FORMAT(" MAINTENANCE",13X,F10.0)
      IF(MODUSE(6).EQ.0)WRITE(Q,7)FMKTRS(K)
    7 FORMAT(" MARKET RESEARCH",9X,F10.0)
      IF(MODUSE(7).EQ.0)WRITE(Q,8)FLNREQ(K),DIVPSH(K),RPY6(K),
     2FINVBD(K)
    8 FORMAT(" NEW LOANS",15X,F10.0," DIVIDENDS PER SHARE",6X,F10.3/
     2" LOAN REPAYMENT",10X,F10.0," INVESTMENT",15X,F10.0)
      IF(Q.EQ.4)WRITE(Q,6666)
      WRITE(Q,700)VSALES(K),BVAL(K),CSTMFG(K),TINVD(K) ,CSTGSD(K),
     2GROSS(K),DEP(K)
  700 FORMAT(/////10X,"INCOME STATEMENT"/10X,"****************"//
     205X,"SALES",25X,F15.0/05X,"COST OF GOODS SOLD"/10X,
     3"BEG INVENTORY",12X,F15.0/10X,"MANUFACTURING COSTS",6X,F15.0/
     410X,"ENDING INVENTORY",9X,F15.0/15X,"COST OF GOODS SOLD",2X,F15.0,
     505X,"GROSS MARGIN",18X,F15.0/05X,"OPERATING EXPENSES"/10X,
     6"DEPRECIATION",13X,F15,0)
      WRITE(Q,9)TRANS(K),WARE(K),ADMS(K)
    9 FORMAT(10X,"TRANSPORTATION",11X,F15.0/10X,"WAREHOUSING",14X,F15.0,
     210X,"ADMINISTRATIVE",11X,F15.0)
      IF(MODUSE(5).EQ.0)WRITE(Q,10)FMAINT(K)
   10 FORMAT(10X,"MAINTENANCE",14X,F15.0)
      IF(MODUSE(4).EQ.0)WRITE(Q,11)PRDDEV(K)
   11 FORMAT(10X,"PRODUCT DEVELOPMENT",6X,F15.0)
      IF(MODUSE(2).EQ.0.OR.MODUSE(3).EQ.0.OR.MODUSE(6).EQ.0)
     2WRITE(Q,12)TMKTD(K)
   12 FORMAT(10X,"MARKETING",16X,F15.0)
      WRITE(Q,13)TEXP(K),OPINC(K),FINTPY(K)
   13 FORMAT(15X,"TOTAL",15X,F15.0/5X,"OPERATING INCOME",14X,F15.0/
     25X,"OTHER EXPENSES",16X,F15.0)
      IF(MODUSE(7).EQ.0)WRITE(Q,14)FINTIN(K)
   14 FORMAT(5X,"OTHER INCOME",18X,F15.0)
      WRITE(Q,15)FINRT(K),TAX(K),FINAT(K)
   15 FORMAT(5X,"INCOME BEFORE TAXES",11X,F15.0/
     25X,"TAXES",25X,F15.0/5X,"NET INCOME",20X,F15.0)
      IF(MODUSE(7).EQ.0)WRITE(Q,16)DIVTOT(K)
   16 FORMAT(5X,"DIVIDENDS",21X,F15.0)
      WRITE(Q,17)ADRE(K)
   17 FORMAT(5X,"ADDITION TO NET WORTH",9X,F15.0)
      IF(Q.EQ.4)WRITE(Q,6666)
      WRITE(Q,18)VSALES(K),TNEWLN(K)
   18 FORMAT(/////10X,"FUNDS STATEMENT"/10X,"****************"//
     25X,"SOURCES"/
     210X,"SALES",20X,F15.0/10X,"NEW LOANS",16X,F15.0)
      IF(MODUSE(7).EQ.0)WRITE(Q,19)FINTIN(K)
   19 FORMAT(10X,"INVESTMENTS" ,14X,F15.0)
      WRITE(Q,20)SOURCE(K),CSHOUT(K),TAX(K),PLNTIN(K)
   20 FORMAT
     2(15X,"TOTAL",15X,F15.0/5X,"USES"/10X,"CASH FOR OPERATIONS",6X,F15
     30/10X,"TAXES",20X,F15.0/10X,"PLANT INVESTMENT",9X,F15.0)
      IF(MODUSE(7).EQ.0)WRITE(Q,21)DIVTOT(K),TOTRPY(K)
   21 FORMAT(10X,"DIVIDENDS",16X,F15.0/10X,"LOAN REPAYMENT",11X,F15.0)
      WRITE(Q,22)USE(K),ADCASH(K)
   22 FORMAT(15X,"TOTAL",15X,F15.0/5X,"ADDITION TO CASH ASSETS",
     27X,F15.0)
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      WRITE(Q,703)CASH(K),TINVD(K),RAWMAT(K),PLANT(K),ASSETS(K)
  703 FORMAT(/////10X,"BALANCE SHEET"/10X,"*************"//
     205X,"ASSETS"/10X,"CASH",21X,F15.0/10X,"INVENTORY",16X,F15.0/
     310X,"RAW MATERIALS",12X,F15.0/10X,"PLANT",20X,F15.0/
     415X,"TOTAL",15X,F15.0)
      WRITE(Q,23)TLNTDT(K)
   23 FORMAT(5X,"LIABILITIES",19X,F15.0)
      WRITE(Q,24)FNETWT(K),TLIAB(K)
   24 FORMAT(5X,"NET WORTH",21X,F15.0/15X,"TOTAL",15X,F15.0)
      IF(Q.EQ.4)WRITE(Q,6666)
      WRITE(Q,704)
  704 FORMAT(///10X,"PRODUCTION AND SALES DATA IN UNITS"/
     210X,"*********************************"//
     318X,"BEG INV",6X,"SHIPMENTS",10X,"SALES",8X,"END INV"/)
      WRITE(Q,705)(J,BINV(J,K),SHIP(J,K),SALUNT(J,K),FINV(J,K),J=1,3)
  705 FORMAT(04X,"ZONE",I2,4F15.0)
      WRITE(Q,706)TBINV(K),PROD(K),TSALES(K),TINV(K)
  706 FORMAT(04X,"TOTALS",4F15.0)
      WRITE(Q,707)RMCOST(K),WAGES(K),OVHEAD(K),CSTMFG(K),RMIN1(K),
     2 RMPUR(K),PROD(K),RMINV(K)
  707 FORMAT(///10X,"MANUFACTURING COST DATA"/
     210X,"************************"//
     2/5X,"RAW MATERIALS",7X,F15.0/
     305X,"LABOR",15X,F15.0/05X,"OVERHEAD",12X,F15.0/15X,"TOTAL",
     45X,F15.0///10X,"RAW MATERIALS INVENTORY (IN UNITS)"/
     510X,"*********************************"//
     5/05X,"BEG INVENTORY",07X,F15.0/
     605X,"PURCHASES",11X,F15.0/05X,"PRODUCTION",10X,F15.0/
     705X,"ENDING INVENTORY",04X,F15.0)
      WRITE(Q,708)EMPL1(K),EMPH(K),EMPF(K),EMPL(K)
  708 FORMAT(///10X,"LABOR REPORT"/10X,"************"//
     2/5X,"EMPLOYEES LAST PERIOD",9X,F15.0/
     35X,"EMPLOYEES HIRED",15X,F15.0/5X,"EMPLOYEES FIRED",15X,F15.0/
     45X,"EMPLOYEES THIS PERIOD",9X,F15.0)
      WRITE(Q,841)PRDCAP(K),COSTRM,WAGE
  841 FORMAT(///5X,"PLANT CAPACITY NEXT PERIOD",F18.0/
     25X,"RAW MAT PRICE NEXT PERIOD",F22.3/
     3 5X,"WAGE COST NEXT PERIOD",F25.2)
      IF(Q.EQ.4)WRITE(Q,6666)
      WRITE(Q,709)ECON,ESTEC1(K),ESTEC2(K)
  709 FORMAT(///10X,"MARKETING INFORMATION"/10X,"**********************",
     25X,"ECONOMIC INDEX THIS PERIOD",4X,F15.2/
     35X,"ECONOMIC FORECAST NEXT PERIOD",1X,F15.2/
     45X,"ECONOMIC FORECAST TWO PERIODS HENCE",F10.2)
      WRITE(Q,882)(J,J=1,3)
  882 FORMAT(/5X,"ZONAL ECONOMIC FORECASTS"//16X,"ZONE",3I10)
      WRITE(Q,838)(ECONZ(J,NPD),J=1,3)
  838 FORMAT(9X,"THIS PERIOD",3F10.2)
      WRITE(Q,839)(ESTZE1(J,K),J=1,3)
  839 FORMAT(9X,"NEXT PERIOD",3F10.2)
      WRITE(Q,840)(ESTZE2(J,K),J=1,3)
  840 FORMAT(3X,"TWO PERIODS HENCE",3F10.2)
      WRITE(Q,710)
  710 FORMAT(//8X,"MARKET SHARE (ESTIMATES)"/)
      WRITE(Q,711)(M,ESTSHR(K,M),M=1,NFIRM)
  711 FORMAT(9X,"FIRM",I2,F15.2)
      IF(MODUSE(4).EQ.0)WRITE(Q,30)
```

```
 30 FORMAT(///11X,"PRODUCT DEVELOPMENT (ESTIMATES)"/)
     IF(MODUSE(4).EQ.0)WRITE(Q,711)(M,ESTPRD(K,M),M=1,NFIRM)
     IF(MODUSE(2).EQ.0.AND.MODUSE(3).EQ.0)WRITE(Q,712)
712 FORMAT(/10X,"MARKETING EXPENDITURES (ESTIMATES)"/
    2" FIRM",4X,"ZONE 1",
    24X,"ZONE 2",4X,"ZONE 3",2X,"NATIONAL")
     IF(MODUSE(2).EQ.0.AND.MODUSE(3).EQ.0)WRITE(Q,713)
    2(M,(ESTZON(J,K,M),J=1,3),ESTNAT(K,M),M=1,NFIRM)
713 FORMAT(I5,4F10.0)
     IF(MODUSE(3).EQ.0.AND.MODUSE(2).EQ.1)WRITE(Q,34)
 34 FORMAT(/10X,"MARKETING EXPENDITURES (ESTIMATES)"/
    2" FIRM",4X,"ZONE 1",
    24X,"ZONE 2",4X,"ZONE 3")
     IF(MODUSE(3).EQ.0.AND.MODUSE(2).EQ.1)WRITE(Q,33)(M,(ESTZON(J,K,M),
    2J=1,3),M=1,NFIRM)
 33 FORMAT(I5,3F10.0)
     IF(MODUSE(2).EQ.0.AND.MODUSE(3).EQ.1)WRITE(Q,35)
 35 FORMAT(/10X,"MARKETING EXPENDITURES (ESTIMATES)"/
    2" FIRM",2X,"NATIONAL")
     IF(MODUSE(2).EQ.0.AND.MODUSE(3).EQ.1)WRITE(Q,36)(M,ESTNAT(K,M),
    2M=1,NFIRM)
 36 FORMAT(I5,F10.0)
 31 CONTINUE
     WRITE(Q,714)
714 FORMAT(///10X,"NEWSLETTER"/10X,"**********"//
    210X,"FIGURES EXPRESSED IN DOLLARS"//
    2" FIRM",5X,"SALES",4X,"PROFIT",5X,"NEW PLANT",5X,"ASSETS",
    24X,"LOANS","    PRICE"/)
     WRITE(Q,715)(M,VSALES(M),FINAT(M),PLNTIN(M),
    2ASSETS(M),TLNTOT(M),PRICE(M),M=1,NFIRM)
715 FORMAT(I5,2F10.0,F15.0,F11.0,F9.0,F9.2)
     IF(NPD.EQ.8)WRITE(Q,1520)
     IF(Q.EQ.4)WRITE(Q,6666)
 891 CONTINUE
     DO 1160 K=1,NFIRM
     GMARG(K)=(VSALES(K)-CSTGSD(K))/VSALES(K)
     PRPER(K)=FINBT(K)/VSALES(K)
     PERASS(K)=FINBT(K)/ASSETS(K)
     IF(TBINV(K).EQ.0..AND.TINV(K).EQ.0.)GO TO 5666
     TURN(K)=2.0*TSALES(K)/(TBINV(K)+TINV(K))
5666 CONTINUE
     DTRAT(K)=TLNTOT(K)/FNETWT(K)
1160 CONTINUE
     DO 1705 LJ=1,NCOPY
     WRITE(Q,99)
     WRITE(Q,1136)NPD,(N,N=1,NFIRM)
1136 FORMAT(/////10X,"ADMINISTRATOR OUTPUT"/10X,"**********************",
    310X,"**********************"/
    3/10X,"PERIOD ",I4///
    2/6X,"FIRM",6I10)
     WRITE(Q,1137)(SHMKT(K),K=1,NFIRM)
1137 FORMAT(" MKT SHR",3X,6F10.2)
     WRITE(Q,1139)(VSALES(K),K=1,NFIRM)
1139 FORMAT(" SALES",5X,6F10.0)
     WRITE(Q,1138)(GMARG(K),K=1,NFIRM)
1138 FORMAT(" GM % SAL  ",6F10.2)
     WRITE(Q,1140)(PRPER(K),K=1,NFIRM)
```

```
1140 FORMAT(" NP % SAL  ",6F10.2)
     WRITE(Q,1141)(PERASS(K),K=1,NFIRM)
1141 FORMAT(" NP % AST  ",6F10.2)
     WRITE(Q,1142)(PRICE(K),K=1,NFIRM)
1142 FORMAT(" PRICE     ",6F10.2)
     WRITE(Q,1173)(ADVNAT(K),K=1,NFIRM)
1173 FORMAT(" NAT ADV   ",6F10.0)
     DO 1146 J=1,3
1146 WRITE(Q,1145)J,(ADV(J,K),K=1,NFIRM)
1145 FORMAT(" ZONE ",I2,3X,6F10.0)
     WRITE(Q,1147)(PRDDEV(K),K=1,NFIRM)
1147 FORMAT(" PRD DEV   ",6F10.0)
     WRITE(Q,1148)(PRDCAP(K),K=1,NFIRM)
1148 FORMAT(" CAPACITY  ",6F10.0)
     WRITE(Q,1149)(EMPL(K),K=1,NFIRM)
1149 FORMAT(" LABOR",5X,6F10.0)
     WRITE(Q,1150)(TURN(K),K=1,NFIRM)
1150 FORMAT(" TURNOVER",2X,6F10.2)
     WRITE(Q,1153)(DTRAT(K),K=1,NFIRM)
1153 FORMAT(" DE RATIO  ",6F10.2)
     WRITE(Q,99)
1705 CONTINUE
     DO 879 K=1,NFIRM
     DO 879 J=1,3
     BINV(J,K)=FINV(J,K)
 879 CONTINUE
1701 CONTINUE
     WRITE(6,1590):READ(5,84)ATEST:IF(ATEST.EQ."NO ")GO TO 1591
1590 FORMAT(///"DO YOU WANT TO UPDATE HISTORY (YES OR NO)")
     NPD=NPD+1
C         ROUTINE TO OUTPUT THE HISTORY DATA
     REWIND 8
     WRITE(P)WAGE,COSTRM,NPD,NFIRM
     DO 7361 K=1,10:DO 7361 N=1,2
7361 WRITE(P)TMNAME(K,N)
     DO 2200 K=1,10
2200 WRITE(P)RMINV(K),PRDCAP(K),PLTLAT(K),EMPL(K),TIMNAT(K),TIMDEV(K),
    2(TIMADV(J,K),J=1,3),TIMPRI(K),WORTH(K),(BINV(J,K),J=1,3),
    3PLANT(K),TLN6(K),TLN20(K),CASH(K),SALAVG  ,SALES1(K)
1591 STOP:END
     END
     FUNCTION EXPON(N,C1,C2,F1,F2)
     DIMENSION C(3)
     EXPON=C1+C2*(1.0-1.75**(-F1*N/F2))
     RETURN
     END
     FUNCTION EXPON1(C,F1,F2)
     DIMENSION C(4)
     EXPON1=C(1)-C(2)*(1.0-C(3)**(-F1/(C(4)*F2)))
     RETURN
     END
     FUNCTION EXPON2(C,F1,F2)
     DIMENSION C(3)
     EXPON2=1.00+C(1)*(1.0/C(2)-C(2)**(-F1/(C(3)*F2)))
     RETURN
     END
     SUBROUTINE GAUSS(IX,S,AM,V)
```

```
      A=0.;DO 50 I=1,12;Y=RANDOM(0)
   50 A=A+Y;V=(A-6.)*S+AM
      RETURN;END
      FUNCTION RANDOM(N)
       DATA Z/0/
       IF(N .GT. 0) GO TO 1000
       I=CONCAT(0,Z,13,31,17)
       J=CONCAT(0,Z,13,14,34)
       Z=CONCAT(0,(I+J+CONCAT(0,Z,13,13,35)),13,13,35)
       GO TO 2000
 1000  Z=CONCAT(0,N,13,13,35)
 2000  RANDOM=Z/34359738367
       RETURN;END
```

APPENDIX C

INSTRUCTIONS TO PARTICIPANTS

Introduction

Since the early thirties aluminum has enjoyed the position of primary metal used in aircraft and missiles. In August of 1954, with the low level flight of the Bell X-15, it was discovered that aluminum begins to lose its strength at speeds above Mach 2.2. This fact has subsequently led to serious repercussions--in mining, in metal manufacturing, in the aerospace industry, in the tool and die makers industry, and in the gem cutting industry.

The fact that aluminum loses its strength characteristics at high temperatures, and thus at high speeds, meant that a search for a more adequate metal was called for. This search for a more suitable metal to be used in the wings and nose of super-sonic and hyper-sonic aircraft and missiles ended with Titanium. Titanium contains all the necessary characteristics required for a good replacement to aluminum in high speed aircraft. Titanium has high plasticity, high tensile strength, extremely good fatigue characteristics, and unlike aluminum has an ability to retain all these desirable characteristics at extremely high air speeds. In fact, Titamium is the perfect metal for aircraft construction. That is, except for one problem; Titanium is an extremely hard metal. The available machine tools were not capable of cutting Titanium at high rates of feed. A new technology of machine tools manufacturing was required.

In 1954 and even as late as 1959, your company was primarily involved in the cutting of industrial diamonds and other precious and semi-precious stones. Since, however, there were no makers of tools for precious stone cutting in the United States, and the makers of such tools outside the United States were generally unreliable, your firm developed a capacity to make their own cutting tools. When the specialty market for tools capable of cutting Titanium began to develop in the late fifties and early sixties, your firm along with its two major competitors saw this market as having high potential for exploiting their tool making capabilities. Your company and its competition entered the Titanium cutting tool market within nine months of one another.

Since entering this specialty tool market, your company has noticed two developments. The first is a general growth in the market; a growth that promises to increase in the coming years. The second development is a small yet noticeable increase in the volume of sales going to existing tool and die makers and to foreign tool makers, especially Japan. When the Titanium tool market was just developing it did not look to the tool and die makers to be a particularly lucrative one. They therefore did not engage in the research and development necessary to catch up to the technological improvements already enjoyed by the gem cutters. Later developments in the market, however, disproved this stand, and the tool and die makers are moving in the direction of the new Titanium tool market.

You and your associates are given the responsibility for managing and expanding one of the larger regional territories of the tool market. This regional territory is the California market. At the present time your major competitors are of approximately the same size and have approximately the same investment in the market.

You and your associates, as an executive team, are given a mandate by your board of directors to establish your firm in the California market; to insure that existing tool and die makers and foreign tool makers do not increase their small share of the market; and finally to do all of this profitably. You have the responsibility of responding to the board of directors with what you feel are appropriate team objectives and policies. Your board of directors has given you from three to five years to accomplish your objectives.

Product

You have a single product to sell in the California market. It is an alloy of diamond shavings, high carbon steel, and tungsten. Its useful life at normal rates of use is three to four months. The shortest it has lasted, in particularly heavy use, is two months.

The California Market

The California market is split into three zones--a northern zone, a central zone, and a southern zone. The northern zone is fairly mountainous and does not have very much industry. Therefore, the sales that you can expect from the northern zone are not as much as from the other two zones. The northern zone is designated as Zone 1. The central zone has a fair amount of industry in it; the sales that can be achieved in the central zone are higher than in Zone 1. The central zone is designated as Zone 2. The southern zone is the largest zone in the market. It has the most industry. The climate in the southern zone is extremely mild and in past years many firms have moved into the zone. The sales potential of the southern zone is higher than the sales potential of Zone 1 or Zone 2. The southern zone is designated as Zone 3.

Production

The machine tool described above is the only product produced by your plant. The production process is very complex. It involves, first, casting the alloy of diamond shavings, high carbon steel, and tungsten into the proper shape for the machine tool, and second, hardening the machine tool by heat treatment.

Since you do not produce the alloy yourself, but buy it already made, your purchasing procedure is simplified. You only have one type of raw material to purchase. Furthermore, since your production only requires one raw material and produces only one product, you can order the raw material in terms of the number of end products it can produce. In other words, instead of ordering two tons of diamond-steel-tungsten alloy, you can order "enough alloy to produce 50,000 machine tools"; when placing an order your purchasing department makes the conversion from machine tools to tons of alloy.

Besides raw materials, your manufacturing costs include direct labor--the wages of those men involved solely in production--the miscellaneous supplies they need to produce the machine tools, and other items, such as electricity, that are expended in producing the machine tools. The supplies and other items are grouped into what is termed "manufacturing overhead".

Other production related expenses include depreciation, transportation, warehousing, and administrative expenses. Depreciation expense is a charge that is incurred because, by continuously producing machine tools, you slowly wear down your plant and equipment. The plant and equipment have a certain useful life, assuming no preventive maintenance, after which time they must be torn down or scrapped and replaced. Depreciation shows the value of the plant and equipment that has deteriorated during the last period of production. Transportation expenses are those expenses that are incurred when machine tools are shipped to the different zones where they are sold. The cost of shipping one machine tool to any zone is 10 cents. Transportation expenses are the fees given to the trucking firms, railroads, and airlines that carry the machine tools to the different markets. Warehousing expenses are those expenses incurred in storing raw materials or finished machine tools. When raw material is ordered, it is economical to order more material than can be immediately used in production. Material is also ordered for future use (generally at least six months). While the material is waiting to be used, it is stored in a warehouse next to your plant. When you have completed work on a batch of machine tools, it is sent to the zones where it is stored in the warehouses of independent storage firms, The cost of storing a machine tool for six months in the warehouses of these firms is 15 cents. Administrative expenses are all those expenses incurred while administering the plant, the employees, and the sales efforts. Management salaries, rent, office supplies, and other such expenses are included in administrative expenses. Initially, administrative expenses also include a charge for advertising effort.

The number of tools that you can produce depends upon three factors: the size of your plant, the number of employees you have, and the amount of raw materials you have available. Any single factor, if not sufficient, can limit your production. Raw materials are ordered, employees are hired and fired, and plant size is increased through additional investment in plant capacity. Since new plant additions cannot be constructed overnight, it is necessary to plan for expansion well in advance. Typical building contracts call for 20 percent of new plant to be available within 12 months and the remainder within 18 months. No new plant can be constructed in fewer than 6 months.

Finances

In any one period, your firm will have available cash balances amounting to beginning cash balances plus one half of that period's dollar sales volume.* In the event that one half of period cash outlays should exceed available cash balances, your firm is subject to an automatic loan. The interest rate on this emergency loan is 20 percent per year. For the

*Note that receipts and disbursements are assumed to be evenly spread over a six-month period.

purposes of interest computation on this loan, it is assumed that all loans are received on the first day of the period. Furthermore, any repayments also occur on this date.

BASIC MODULE INSTRUCTIONS

I. DECISIONS

As the head of your firm, you and your associates must make the following decisions as you strive to achieve your objectives.

Number of machine tools to be produced or "Production" How many tools do you want to produce during the next six months (one period)?

Number of employs to be hired How many new workers will you need in order to meet your production schedule? An average worker is able to produce roughly 300 tools in a single six month period. Note that it costs about $2,000 to prepare a new employee for work.

Number of employees to be fired In the event that you plan to reduce production levels, you may find it desirable to lay off unneeded workers. Because of your various commitments to a local labor union, it costs $1,000 in severance pay for every employee laid off.

Amount of new plant to be built How many dollars do you plan to spend on increasing plant capacity? It has been estimated that a one unit increase in plant capacity will accrue to roughly ten dollars of new plant investment. Only 20 percent of this increase in capacity will be available in the period following that in which the investment takes place. The remainder will be available in two periods.

Amount of raw material to be ordered How much raw material do you want to add to your raw material inventory? Raw materials are measured in number of machine tools that can be made from the materials.

Price to be charged At what price do you offer your machine tools?

Repayment of emergency loan In the event that you have needed emergency financial help, you may desire to repay all or a portion of outstanding debts. Emergency loans are charged interest at the rate of 20 percent per annum.

II. REPORTS

Your position at the end of each period is reported to you through the following reports.

Input Decisions A listing of the decisions you made at the start of the period.

Income Statement The income statement lists sales, expenses, and income for the period. Sales are how many tools (in units) you sold last period times the unit price you charged. Cost of Goods Sold is the expense of producing those units sold. It is arrived at by subtracting the dollar change in finished goods inventory from production costs for the period. Gross Margin is sales less cost of goods sold. Operating Expenses are the sum of depreciation, transportation, warehousing, and administrative expenses. Operating Income is gross margin less operating

expenses. Other Expenses are interest paid on all forms of debt financing. Income before taxes is operating income less other expenses. Taxes are federal income taxes (all income is taxes at 52 percent). Net Income is operating income less taxes.

Funds Statement The funds statement shows the sources of cash, cash disbursements and the net addition to or deletion from cash. The items in the funds statement are self-explanatory with the exception of cash for operations. Cash for operations is labor expense plus manufacturing overhead plus purchases of raw materials plus operating expenses less depreciation (a non-cash expense).

Balance Sheet The balance sheet lists the Assets, Liabilities, and Net Worth of your company. Assets will always equal net worth plus liabilities. Assets include cash, finished goods inventory priced at cost, raw materials inventory, and value of plant and equipment. Liabilities include all forms of debt financing. Net Worth represents the excess of assets over liabilities or the value of ownership in the company.

Production and Sales Data in Units This report shows, for each zone and for all zones combined: (1) beginning inventory of finished goods (machine tools) in units, (2) shipments made to the zones last period, (3) sales made in each zone, and (4) ending inventory of machine tools (those machine tools left in the zones and available for sale next period).

Manufacturing Cost Data This report breaks the manufacturing cost figure included in the income statement into its components: value of raw materials used, direct labor used, and overhead allocated to manufacturing.

Raw Material in Units This report accounts for changes in raw materials inventory. Purchases of raw materials are added to beginning inventory from which production needs are subtracted to determine the ending inventory of raw materials in units.

Labor Report This report accounts for changes in the plant's labor force. Employees hired at the beginning of the period are added to those employed at the end of the previous period; from this sum employees fired at the beginning of the period are subtracted to yield employees available for this period.

Marketing Information Report The health of the economy is characterized for the period just completed and for the next two periods by an economic index. The marketing information report includes the index for the period just completed and forecasts the index for the next two periods. The "norm" or "standard" for the index is 1.00. A forecasted index of 1.05, for example, would indicate an expected upswing in the general level of economic activity and would also signal an increase in the demand for machine tools.

Zonal Economic Indices Just as the economy as a whole is characterized by an economic index, so is the economy of each of the zones in the California market. Also, just as for the economy as a whole, this report includes the indices for three periods--the period just completed and the next two. The "norm" or "standard" is again 1.00.

Market Share Estimates Your firm and each of your competitor firms are competing for the California machine tool market. This report gives an estimate of the proportion of the total market sales in units you and each of your competitors achieved in the period just completed.

Newsletter The newsletter contrasts the operating results of you and your competitors. Sales, profit, new plant, and assets for each firm are listed.

Productivity Next Period This figure describes the size (in terms of machine tools that can be produced) of your plant for next period.

Raw Materials Price Next Period This figure indicates what each unit of raw material will cost you when you order next period.

Wage Cost Next Period This figure indicates the six-month's wage of each employee for next period.

MODULE 1 INSTRUCTIONS

SHIPMENTS TO ZONES

Since the research project is complete, you now have to allocate your production to the three market zones. You have to designate the shipments to the zones. Since you have no facilities for inventorying finished goods at your plant, you must warehouse all production in the zones. This means that you will decide what to ship to Zone 1 and 2. Zone 3 shipments are thereby indirectly determined. Zone 3 shipments will be total production for the period less the shipments to Zones 1 and 2.

For the past several quarters, your marketing research department has been making shipping decisions as a means of studying the market potential of the different California zones. They have estimated the percentage breakdown of the total California market demand for machine tools as: Zone 1 -- 20%; Zone 2 -- 30%; and Zone 3 -- 50%. The cost of shipping one machine tool in any zone for six months (one period) is one dollar. If a unit is sold in a given period, the estimated inventory charge for that unit is 50 cents. Shipping cost shows up under transportation expenses on the income statement. Warehousing expenses are also listed under operating expenses on the income statement.

MODULE 2 INSTRUCTIONS

NATIONAL ADVERTISING

Up until now you have been promoting your machine tools on a piece-meal basis. Circulars telling about your machine tools have been periodically sent throughout California. Also, an occasional ad has been placed in relevant trade publications. Your board of directors has recommended that you begin state-wide advertising and drop all other minor promotions. You have the ultimate say as to how much money is spent on advertising in each period.

Note that past promotional expenses have been included as part of administrative expenses on the income statement. Advertising expense will now be separated. You can, therefore, expect a drop in administrative expenses resulting from your assumption of this marketing function. In the past you have been spending approximately $50,000 on promotion each period. Your board of directors feels that substantially more than $50,000 should be expended on future state-wide advertising. They believe that this advertising will benefit you by stimulating the general demand for machine tools and for your product in particular.

Your state-wide advertising expenditures will be reported in the Marketing Expenditures Report. This report will also show estimates of marketing expenditures of your competitors.

MODULE 3 INSTRUCTIONS

ZONAL ADVERTISING

Your board of directors has decided to add newspaper and other localized advertising to your marketing efforts. State-wide advertising has the disadvantage of covering the whole state equally when the three zones may have different strategic importance for your firm.

For each zone, you have to decide how much zonal advertising to spend for advertisement of your product in that zone. Your board of directors feels that a total zonal advertising budget in excess of $15,000 per zone for the first six months would be appropriate.

Your zonal advertising expenditures and estimates of the zonal advertising expenditures of your competition are reported in the Marketing Expenditures Report.

MODULE 4 INSTRUCTIONS

PRODUCT DEVELOPMENT

As a means of increasing the technical attractiveness of your machine tool, the board of directors feels that research funds should be spent on further development of your machine tool. Each period, you have complete discretion on the size of this product development expense.

Expenditures on product development will tend to increase your sales levels in all zones during the period that you make the expenditure. As with state-wide and zonal advertising, product development will tend to increase the loyalty of your customers.

Product development expense is listed separately in the income statement under operating expenses.

MODULE 5 INSTRUCTIONS

MAINTENANCE

As you produce machine tools, the productive capacity of your plant wears away. Machines that produce very rapidly while new, slow down with age. Also, as machinery gets older, it breaks down more frequently, meaning that fewer units can be produced per day.

One way of slowing down the rate of deterioration of your plant is to spend money and effort in preventive maintenance. If money is spent oiling the machinery regularly, making spot checks of the machinery to prevent breakdowns, and generally trying to keep the machinery in good condition, the productive capacity of your plant will not decrease as quickly.

You have to decide each period how much money should be spent on maintenance. This expense is listed as an operating expense on your income statement.

MODULE 6 INSTRUCTIONS

MARKET RESEARCH

In the past, you have been receiving information on your competition and on the economy. The economic index for this period and for the next two periods, the zonal economic indices for this period and for the next two periods, market share, product development expenditures of your competition have all been estimated by either taking the figures from government reports or by asking your sales personnel. Your board of directors feels it would be wise to spend some money in "marketing research" to improve the accuracy of these estimates. Similar expenditures in other industries average $10,000 per six-month period with heavier outlays coming during strategic periods.

In general, the more money you spend, the better will be the estimates of the economic indices and the information on your competition. The market research expenditure is included as part of marketing expenses on the income statement.

MODULE 7 INSTRUCTIONS

BORROWING AND LOAN REPAYMENT, INVESTMENT IN BONDS, DIVIDENDS PER SHARE

Your firm has just completed an arrangement with a local bank. The bank will loan you money for operations whenever you request; your line of credit will be $500,000. The interest charge on any outstanding balance is 6 percent per annum. A loan can be paid back at any time.

As a means of using your excess cash and increasing profits, your board of directors suggests that you invest in bonds that return 4 percent per annum. Remember that bonds are not considered a cash balance and if you invest too heavily you face the possibility of receiving an emergency loan at a charge of 20 percent per annum.

The board of directors, who own a large portion of your outstanding common stock, feel you should pay some dividends to the people who have invested in your company. You make the dividend decision on a per share basis (150,000 shares outstanding).

The new loans you make will appear in the Sources portion of the Funds Statement as well as in the Liabilities section of the Balance Sheet. The interest on the loans will appear as Other Expenses on the Income Statement. Any repayment of loans will appear in the Uses portion of the Funds Statement.

The interest that you receive from the investment in bonds appears as a Source in the Funds Statement and as Other Income in the Income Statement.

The dividends that you pay will appear as Dividends in the Income Statement and as a Use in the Funds Statement.

APPENDIX D

QUESTIONNAIRE

1. What aspect of your experience as a corporate manager taught you the most? _____

   _____

2. What did you enjoy the most about your experience? _____

   _____

3. Would you like to have played more periods? _____

4. Would you prefer to have played over a longer period of time but not on an everyday basis? _____

5. Rank the following with respect to their effects on demand.

   State-wide advertising _____

   Product development _____

   Price _____

   Zonal advertising _____

6. Did you feel the written instructions were:

   Too detailed _____

   Not detailed enough _____

   Adequate _____

7. Would you have liked more class discussion between plays? _____

8. Would you have liked more time to make decisions? _____

9. Was your team organized along functional lines (i.e., a marketing manager, a production manager, etc.) or did you make decisions as a committee?

   _____

10. Do you feel that your team was:

Aggressive _____

Competitive _____

A follower _____

11. If you were to rank the different educational experiences you have had in your high school program from most beneficial to least beneficial, where would you rank the production management simulator?

First quintile _____

Second quintile _____

Third quintile _____

Fourth quintile _____

Fifth quintile _____

12. If you were to improve the production management simulator, what changes or additions would you make? _____

_____

_____

_____

13. Comments: _____

_____

_____

_____

14. Can you think of any other classes that might be able to use a computer simulation? How? _____

_____

SUMMARY OF RESPONSES TO QUESTIONNAIRE

1. What aspect of your experience as a corporate manager taught you the most?

   One-third of the participants felt that interpreting available data for decision-making purposes was the most valuable part of their experience. Three thought that learning how to accept a loss was what taught them the most. The remaining participants singled out their knowledge of the importance of some specific economic aspect such as the significance of consumer loyalty and the effects of supply and demand on price.

2. What did you enjoy the most about your experience?

   Over half of the participants answered with competition. One student liked the "realism" of the experience. The rest enjoyed getting the computer feedback and seeing the results of their decisions.

3. Would you like to have played more periods?

   Yes - 17 No - 1

4. Would you prefer to have played over a longer period of time but not on an everyday basis?

   Yes - 15 No - 3

7. Would you have liked more class discussion between plays?

   Yes - 13 No - 5

8. Would you have liked more time to make decisions?

   Yes - 14 No - 4

11. If you were to rank the different educational experiences you have had in your high school program from most beneficial to least beneficial, where would you rank the production management simulator?

    Ten students put it in the first quintile; four in the second; four in the third; none in the fourth or fifth.

12. If you were to improve the production management simulator, what changes or additions would you make?

    One-third of the participants wanted to be able to make more decisions. Three noted that there should be fewer computer mistakes in the print-out. One student wanted to deal with more crises such as the labor strike; one wanted more stress on advertising; one wanted less emphasis on consumer loyalty. Several would have made no improvements or additions.

MURRAY 8-9461

RUSSELL J. MEDKEFF
30 STEEPLECHASE ROAD
DEVON, PENNSYLVANIA 19333

July 13, 1969

Mr. Douglas D. McNair
2793 Highland Avenue
Broomall, Pennsylvania

Dear Mr. McNair:

My apologies for my delay in writing this letter and my thanks for presenting a stimulating educational experience to high school seniors at a time of year in which stimulus is rare. The micro-economic program succeeded in exciting students whose participation throughout the year had been only marginal. One was sufficiently inspired to change an almost sure failure into a final exam "C". I cannot attribute this to your program but am wondering if the insights gained through it may have helped make his review seesions more meaningful. Thank you. An opportunity to repeat the program or a variation of it next year would be most welcome.

The suggestions which the class discussed are listed below.

1. Time: More time needed for decisions. Either sessions should be scheduled twice a week, preferably Tuesday or Wednesday and Friday, or printouts should be returned the day decisions are made to enable students to spend evening time studying results. (Some told me they spent hours with old printouts although they had simply quit working in other classes.)

2. Information: More needed on the effects of advertising, market research, and maintenance. In reference to maintenance, there was no clear understanding of the effect of a lack of it.

3. Clarification needed: Students failed to realize that "national" advertising was actually only state-wide in some instances.

4. Maintenance again: Is it charged pre module 5?

5. Cash holdings: Increasing the options for the use of cash holdings was suggested.

6. Wages: Students suggested that a break-down of wages for social secuity, fringe benefits and basic wage would be useful, even if not needed for actual operation of the program.

7. Preparation of students: Presentation of the reading material the day before the actual introduction is made would give students a chance to read, be better prepared to understand the introduction, and to raise more questions prior to the first decision.

8. Instructions about the report to the Board of Directors should be more explicit. Students were not clear in their understanding of the kind and quantity of information such a report should contain.

9. A final written report on the company goals, plans, and excuses would provide a clarification of these on the part of students as well as a good indication of their degree of understanding of the whole micro-economic program.

I hope that these notes will be of some value to you. And I wish again to express the appreciation of the students and myself for an interesting program.

The gift to Children's Hospital was duly acknowledged by the hospital and the letters you duplicated arrived.

Very truly yours,

Ellen R. Medkeff

Ellen R. Medkeff
Lower Merion High School

APPENDIX E

INSTRUCTIONS TO ADMINISTRATOR

The purpose of these instructions is to explain the interface between the game administrator and the computer. The format is to present chronologically, the messages printed by the computer and follow each message with a description of alternative responses open to the game administrator. In the margin, an (A) will denote administrator supplied messages, and a (C) will denote computer supplied messages.

Prior to using the business game, the game administrator must establish a connection with the computer. This is done by dialing the number of the computer. The "signing onto" the computer will differ depending upon which computer system is being used by the high school. This is normally a simple process and is explained thoroughly by the computer system.

The general sequence of events when the administrator is communicating with the computer is that the computer asks a question by typing a line or lines on the teletype; the administrator answers the question and then hits the carriage return. Note that a carriage return follows all data input from the administrator as this is what signals the computer to accept data transmission. The computer will acknowledge any such transmissions with a line feed. When the computer needs input after asking a question, it will so signify by typing a question mark. In the event that more than one piece of data is needed, data must be separated by commas.

To the computer, the name of the high school game is HGSGME. Once the computer is communicating with the teletype, in other words, the computer has been "signed onto", the business game program is run by typing

```
RUN HGSGME                                                    (A)
```

When HGSGME starts running, the computer asks its first question.

```
INPUT A RANDOM START (5-7 CHARACTERS AND ODD)                 (C)
?
```

The proper response is a random number that is five to seven characters in length and odd. This number is used by the computer to initialize a random number generator. By changing this number, the administrator can change the flow of random events such as variance in market research estimates, subtle differences in zonal demand, and so on. A sample response is

```
982563,                                                       (A)
```

The computer then asks

```
INPUT 7 MODULE CODES (1 IF TEAMS DON'T PLAY)                  (C)
?
```

Presumably, the administrator has previously selected the decision set that the teams are to play in the current period. He now conveys this information to the simulator by specifying seven module codes separated by commas. If teams are not to make the decisions included in a particular module, the code for that module is 1. If teams are going to make those decisions, the code is 0. Modules are:

1. Shipments to zones
2. National advertising
3. Zonal advertising
4. Product development
5. Maintenance
6. Market research
7. Finance

See the section dealing with simulator design for the decisions included in each of the above modules.

A typical module configuration might be the basic module plus modules 1, 2, 3, and 6. In this case the administrator would input module codes

```
0,0,0,1,1,0,1,                                    (A)
```

The computer then asks

```
IS THIS PERIOD ONE (YES OR NO)                    (C)
?
```

An administrator response of "yes" will cause the simulator to initialize all history files to the starting position. In addition, certain other questions will be asked. The period one message-response series would appear as follows:

```
YES                                               (A)
```

Then the computer types

```
INPUT NUMBER OF TEAMS TO PLAY                     (C)
?
```

The maximum number of teams that can participate is ten. An appropriate response for a class of 36 might be 6 (i.e., 6 teams of 6).

```
6,                                                (A)
```

This is followed by a series of computer queries.

```
INPUT NAME FOR TEAM 1                             (C)
?
.                                                  .
.                                                  .
.                                                  .
INPUT NAME FOR TEAM 6                             (C)
?
```

The administrator responds with alphanumeric team names that can be chosen by team members or in any other convenient fashion. A tean name can have no more than twelve characters. An acceptable team name might be

```
MALIBU TOOLS                                    (A)
```

In the event that the period being played is not period one, the administrator would so answer and would not be requestioned regarding the number of participating teams or their names.

The only data that remains to be communicated to the simulator is the respective team decisions. Obviously, the data required will be dependent upon the decision modules played. In any event, the program will request the data needed for the basic decision module.

```
TEAM 1
   PRODUCTION VOLUME
   PRICE
   EMPLOYEES HIRED
   EMPLOYEES FIRED
   RAW MATERIAL PURCHASES
   NEW PLANT
   REPAYMENT OF 20% LOAN                        (C)
   ?
```

A sample response to this message is

```
120000,20.50,10,0,130000,50000,0,               (A)
```

Depending upon the decision modules chosen, additional messages and responses could be

```
SHIPMENTS TO ZONE 1
SHIPMENTS TO ZONE 2
?                                               (C)

50000,40000,                                    (A)

NATIONAL ADVERTISING
?                                               (C)

50000,                                          (A)

ZONE 1 ADVERTISING
ZONE 2 ADVERTISING
ZONE 3 ADVERTISING
?                                               (C)

20000,20000,10000,                              (A)

PRODUCT DEVELOPMENT
?                                               (C)

20000,                                          (A)
```

```
MAINTENANCE EXPENDITURE
?                                                    (C)

60000,                                               (A)

MARKET RESEARCH
?                                                    (C)

30000,                                               (A)

REPAYMENT OF 6% LOAN
INVESTMENT IN BONDS
6% LOAN REQUESTED
DIVIDEND
?                                                    (C)

10000,300000,0,.15,                                  (A)
```

The simulator will cycle through this input series until the decisions for all teams have been transmitted.

The simulator will now proceed to perform the recessary computational functions and print the output of the various teams. Output requires roughly six minutes of terminal time for each team participating. Once all output has been printed, the simulator will want to know if it should update the history files.

```
DO YOU WANT TO UPDATE HISTORY (YES OR NO)
?                                                    (C)
```

In general, the administrator will respond with

```
YES                                                  (A)
```

If, however, some portion of the output was unsatisfactory (i.e., an incorrectly typed input), he may not desire to update the history so that he can replay the same period. In this case, the appropriate answer to the above question would be "NO". Notice that once the history decks have been updated, the period cannot be replayed without restarting the game at period one.

The computer will signal the completion of a run by printing

```
END HGSGME                                           (C)
```

To break off contact with the computer, the administrator prints

```
BYE                                                  (A)
```

The system will respond with some time and charge figures to acknowledge job conclusion.

****

ADMINISTRATOR OUTPUT
****
****

PERIOD 11

FIRM	1	2	3	4	5
MKT SHR	0.21	0.25	0.12	0.20	0.22
SALES	2482509.	2806802.	1578985.	2434413.	2650618.
GM % SAL	0.37	0.32	0.03	0.36	0.38
NP % SAL	0.02	-0.04	-0.31	0.02	0.04
NP % AST	0.02	-0.06	-0.27	0.03	0.06
PRICE	20.05	19.25	22.00	20.25	20.07
NAT ADV	50000.	150000.	15000.	50000.	75000.
ZONE 1	40000.	40000.	5000.	30000.	45562.
ZONE 2	30000.	35000.	10000.	40000.	31681.
ZONE 3	60000.	75000.	20000.	60000.	31821.
PRD DEV	15000.	10000.	3000.	25000.	47347.
CAPACITY	131792.	141562.	148547.	144884.	139388.
LABOR	132.	165.	158.	125.	146.
TURNOVER	10.79	15.98	1.29	8.83	44.92
DE RATIO	0.00	0.00	0.03	0.00	0.00

****

12
11**********
10
9
8
7
6
5
4
3
2